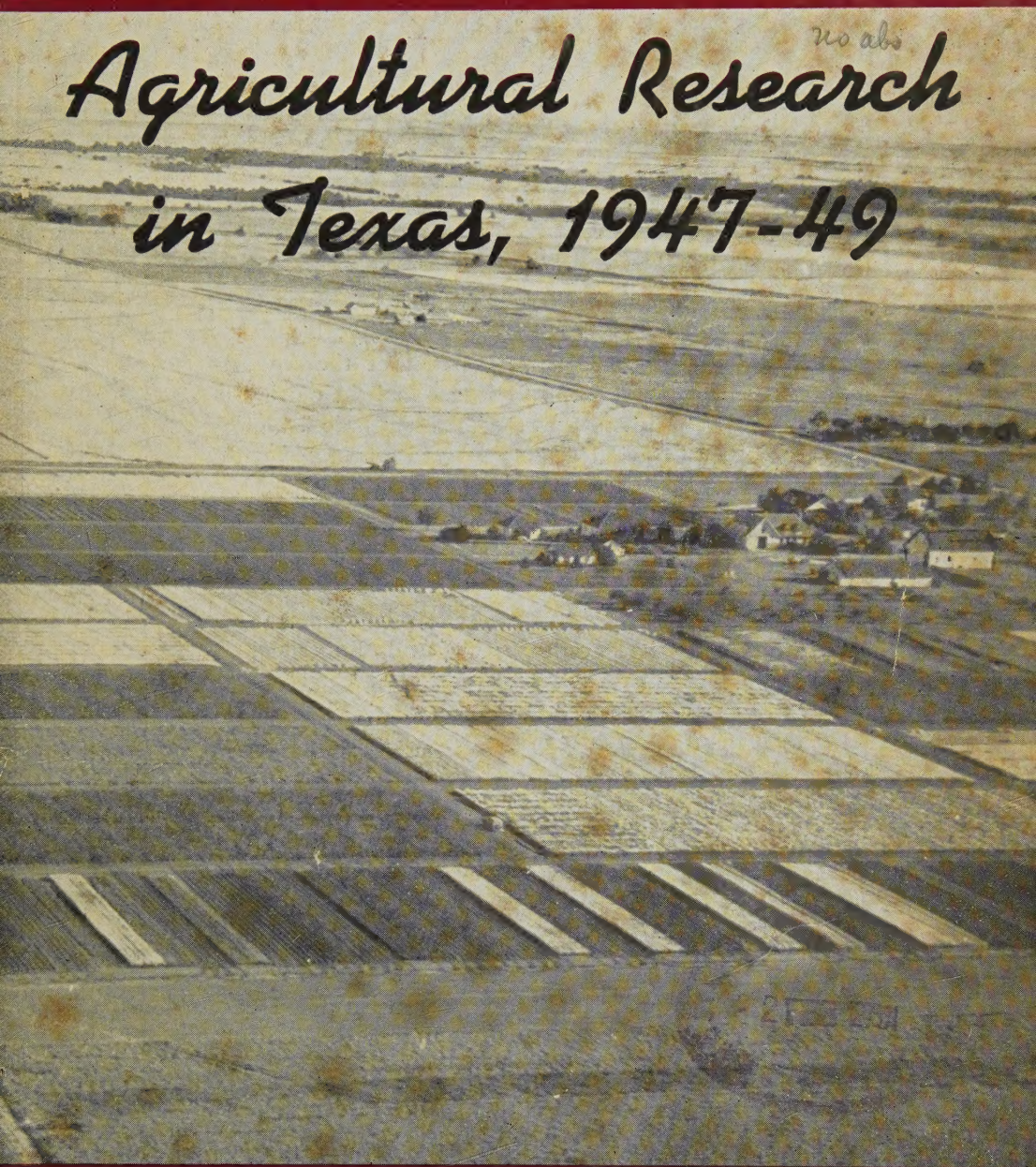
TEXAS AGRICULTURAL EXPERIMENT STATION
R. D. LEWIS, Director, College Station, Texas

Agricultural Research in Texas, 1947-49



The TEXAS AGRICULTURAL AND MECHANICAL COLLEGE SYSTEM
GIBB GILCHRIST, Chancellor

The Cover Picture

An air view of the Denton station, officially Substation No. 6 in the field units of the Texas Agricultural Experiment Station.

Research at Denton is primarily devoted to small grain (wheat, oats and barley), legumes and pastures. About 75 percent of the wheat varieties now planted in Texas had their origin wholly or in part at the Denton station. New Nortex oats, likely the most widely planted oat variety in the United States, originated here. Quanah wheat and Mustang oats, two new varieties released for 1950 seed increase, are products of this station.

Small grain work at Denton is cooperative between the Texas Agricultural Experiment Station and the Division of Cereal Crops and Diseases, Bureau of Plant Industry, Soils and Agricultural Engineering, U. S. Department of Agriculture.

The many grain, legume and grass fields of various sizes and stages of development are largely responsible for the intriguing patterns shown in this picture.

Station headquarters' buildings are shown at the right center. These include the main office building and laboratory, barn used for seed storage, implement storage building and houses occupied by the personnel.

The Denton station has a field day each spring that usually is attended by 2,500-3,000 farmers in the northern Blackland and Grand Prairies.

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Foreword

In this report are many highlights of the agricultural research done during 1947, 1948 and 1949 by the workers of the Texas Agricultural Experiment Station and cooperating agencies.

These are arranged according to the major groups of sciences and services related to agriculture; such as agricultural economics, agronomy, animal husbandry, horticulture, feed control, and so forth.

The Texas Agricultural Experiment Station is part of The Agricultural and Mechanical College System of Texas. The Station had its beginning April 2, 1887, when the Legislature of Texas accepted the Federal Hatch Act, passed by Congress just one month earlier, and authorized "under direction of the college . . . , established . . . in accordance with the provisions" of the Morrill or Land-Grant Act of 1862, "a department to be known . . . as an 'agricultural experiment station'." Thus, the Agricultural and Mechanical College of Texas became the parent of the Texas Agricultural Experiment Station. Five congressional acts and numerous acts of the Legislature of Texas recognize this part of the Texas A&M College System as the public agricultural research agency of the State of Texas.

The Station is administered by a director, who is responsible to the Chancellor and Board of Directors of the Texas A&M College System.

This agricultural research organization consists of the Main Station at College Station, 22 substations and 10 field laboratories owned by the "Station," and 12 cooperating field stations or laboratories owned by other agencies, including the U. S. Department of Agriculture, King Ranch, Texas Technological College and a Soil Conservation District.

There are 16 subject-matter departments and four service groups at the Main Station.

Through its main station, substations, field laboratories and the cooperating units, the Texas Agricultural Experiment Station serves 36 major type-of-farming areas with a combined area as large as 6 southeastern or 12 northeastern states.

The great size of the State, the diversity of soil, climate, native vegetation, types of farming, and market facilities require research peculiarly adapted to the major variations. Over 250 different soil types exist, annual average rainfall varies from above 55 inches to fewer than 10 inches from east to west, elevations of agricultural lands range from sea level to nearly a mile high, and growing seasons average from above 330 days to fewer than 180 days. Nearly every kind of crop and livestock to be found in the United States with their accompanying pests of insects, diseases and weeds, occur in Texas.

Like similar stations in the other 47 states and 3 territories, the Texas Station is composed essentially of five elements:

1. Problems to be solved.

2. Equipment, including land, buildings, livestock and many kinds of apparatus and machines.

3. Workers, including professional research workers, technicians, laborers, stenographers and clerks of many different qualifications.

4. Funds.

5. A spirit of objective study and service to Texas agriculture, rural living and related industries.

In its laboratories and offices, in its fields and gardens, through its livestock and poultry, and on the farms and ranches, Texas Station workers seek the *whats, whys, whens, wheres* and *hows* of hundreds of important problems that confront the operators of these farms and ranches, of rural and urban homes and related industries.

This Station has good reason to be proud of its contribution to the store of agricultural knowledge. Its workers have developed new facts, new methods, new materials and better plants and animals, which each year repay many times all the funds provided for the Station's operations. Many of its findings and new developments through the years are used in high school and college classrooms, and have become commonplace practices by Texas farmers and ranchmen.

Among significant developments during 1947-49 that have and will further affect agricultural research by the Texas Station, we mention briefly:

1. The creation of coordinated departments in agriculture, in which research, college instruction and extension teaching are combined under a single head for each subject-matter department (for instance animal husbandry). These departments are, therefore, common and united for the Agricultural Experiment Station, the School of Agriculture of the A&M College of Texas and the Agricultural Extension Service. The interplay of research and instruction vitalizes and strengthens each of these three functions.

2. The further development of coordinated programs of research among the subject-matter departments, the substations and field laboratories, to the end of gaining concerted attacks on problems from several viewpoints and under several environmental situations.

3. Professional improvement of the staff through graduate study has gone forward rapidly. Furthermore, through 30 or more graduate assistantships, the Station provides opportunities for graduate study by potential research workers, teachers or specialists for industry, while the holders of these assistantships aid in advancing specific investigations under research leaders of the Station.

4. A significant expansion of research on important problems has taken place as a result of the Federal Research and Marketing Act of 1946, under which appropriations first became available to this station late in 1947. Major emphasis under this Act has been given to work on problems of interstate and regional significance.

5. The State Legislature, recognizing that agricultural progress depends upon research, made significant increases available to the Station at the sessions in 1947 and 1949.

6. A gratifying recognition of the quality and value of research by the Station is shown in the greatly increased number of individuals, firms and associations that have voluntarily made funds available as grants-in-aid, thus making possible intensification or expansion of specific research programs and projects of the Station.

7. The research programs and the projects within these programs have undergone searching analysis. From 1946 to 1950, a total of 186 projects were completed or terminated, 34 were revised and 185 new ones were initiated. Some of these new ones represent programing of studies that had previously been conducted on an exploratory or informal basis.

At the end of 1949, there were 260 active projects directed toward the solution of important fundamental and practical problems of Texas agriculture. In our files is a backlog of nearly as many more that have been suggested by farmers, ranchmen, county agents, teachers, industries and research workers looking to the future.

A goodly number of these projects are directed toward fundamental studies, which may or may not give rise to the background information essential to the

future solution of practical problems. The wider our fundamental knowledge, the more likely we can be able to meet practical problems.

8. The substations and field laboratories have become more and more centers of agricultural demonstration and instruction. Visitors are now counted in the several thousands at most of the locations.

We of the Texas Station acknowledge with appreciation the excellent cooperation that we enjoy with several bureaus of the U. S. Department of Agriculture, Texas Technological College, King Ranch, the other parts of the Texas A&M College System, and numerous other public and private agencies. Especial appreciation is extended to hundreds of farmers and ranchmen for their assistance in some of these investigations.

Agricultural research benefits all citizens. It is the city dweller's assurance of abundant, high quality, nutritious and health-promoting foods, of fibers and of numerous raw materials for manufacturing plants. From research comes the means of preserving water supplies for drinking, sanitation, manufacturing and beautification. Much of industrial, as well as of agricultural progress, depends upon increasing the production per farm worker. This can be done through advances in agricultural science and technology based on experimentation, education and demonstration.

R. D. Lewis

Director
Texas Agricultural Experiment Station

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Agricultural Research in Texas, 1947-49

Agricultural Economics and Sociology

FARM MANAGEMENT

FARM MANAGEMENT RESEARCH is aimed primarily at the problems of organizing and operating individual farms on the widely different types of land resources available to Texas farmers.

The first step has been to divide the State into areas of similar land resources and patterns of land use and to develop a broad understanding of the important factors affecting land use in each area.

Detailed studies of the organization and operation of representative groups of farms follow for each area. These studies develop much of the basic information needed to evaluate proposed or probably changes in the organization of the farm business and in the production practices followed in farm operation. They also provide basic information for estimates of production costs.

A third step involves studies of individual farm practices or of the combinations of practices used in the production of a certain crop or type of livestock.

These studies are made when such a crop or type of livestock represents a new enterprise on the farms of an area or when some important change in farm practice is being adopted by the farmers of the area. They are designed to bring the information pertaining to the area up to date and to provide the basis for anticipating the effect of the change or changes on basic costs and on the size, organization and operation of farms in the area.

Studies under way during 1947-49 included:

Efficient Use of Agricultural Resources in the Coast Prairie

This study made possible an analysis of alternative uses of land under the widely different price levels and price relation-

ships which prevailed between 1940 and 1947. It was concluded that row crops (with emphasis on cotton) provide the best alternative for the average farm on the better drained, dark heavy soils. With land of below average productivity, the most profitable systems of farming center around cattle and improved pastures.

A detailed analysis of these alternatives has been prepared and will be published in the near future.

Land-use Adjustments in the West Cross Timbers

This study indicates that a limited number of cash crops are well adapted to the area. Peanuts are the most dependable cash crop, particularly on the deeper sandy soils. Vetch (a relatively new crop) holds considerable promise as a cash crop, as a pasture and hay crop and as a soil conserving crop. Fall-seeded vetch and rye provide good quality winter and spring pasture; this is important in the maintenance of either dairy or beef herds.

A discussion of land-use adjustments in the West Cross Timbers area is being prepared for publication.

Management Problems of Irrigated Farms on the High Plains

Consideration is given to the effect that the amount of water and the time and frequency of its application has on production. Other detailed information obtained concerns the production and production requirements of each irrigated crop.

Particular attention is given to pumping costs and to the factors affecting these costs. Special equipment has been used during each of the past 3 years to measure pumping lift and discharge rates. These two factors are believed to be most important in determining pumping costs.

Progress and preliminary reports have been issued on this study, including a personal report to each cooperating farmer showing his own pumping costs for 1947, and the average pumping costs with each of the fuels used—butane gas, gasoline, natural gas, diesel fuel and electricity.

Mechanized Cotton Production and Competing Enterprises

Emphasis has been focused on the problems centering around the harvesting of cotton by mechanical means, mainly in the High Plains where natural conditions are favorable to the operation of mechanical strippers. Production practices, performance rates, waste comparisons and costs and returns under different harvesting procedures were studied on selected farms for the 1944, 1947 and 1948 seasons. Reports of the studies for these years have been published.

Favorable results have been obtained with strippers only

after frost has removed the foliage from the plants. The study indicates that mechanical strippers may be used to greatest advantage after a previous harvesting by hand. This conclusion may be changed by improvements in defoliants, in ginning equipment and in other related factors, such as the breeding of cotton varieties better suited to mechanical harvesters.

Practices centering around a new competing crop—flax—were studied in 1949. The Texas acreage of flax increased from 20,000 in 1939 to 277,000 in 1949. A publication recently released gives information on the production and production requirements of this crop.

Cotton Production Practices by Type-of-farming Areas

This was the Texas phase of a belt-wide study, and included seven major areas in Texas. The object was to provide comparable and up-to-date information on cotton production practices and requirements for all the major cotton producing areas and to provide a bench mark for measuring the extent of future changes in practices. The data are for the crop year 1947.

Individual reports giving results of the study have been published for the Lower Rio Grande Valley, the Corpus Christi cotton area, the Coast Prairie, the Rolling Plains, the High Plains cotton area, the Blackland Prairie and the Northeast Sandy Lands.

MARKETING OF FARM PRODUCTS

Marketing research the past 3 years covers developments under the Research and Marketing Act of 1946. Increases in funds permitted a considerable addition to the research personnel. During these early days under RMA, marketing research has become highly specialized by commodities.

The Texas Station has, in cooperation with eight other Southern States, made a study of the extent and significance of the seasonal egg surplus problem. Another phase of the egg marketing study centered on the effect of an egg grading program on the producer's income from his flock. It is evident that farmers can materially increase their income by marketing high quality eggs on a graded basis.

A study of the seasonality aspects of the dairy industry is underway. This study seeks the best means of adjusting production of milk to market demands through a leveling of the production pattern.

Cost and efficiency have been emphasized as an important phase of research of citrus and tomato marketing. Cost records have been obtained from firms packing tomatoes. An analysis of these records reveals the more desirable practices and pro-

cedures which, if widely adopted, should materially reduce the costs of tomato marketing. Attention has been given to costs of marketing fresh citrus and the costs of processing and marketing citrus juices. Cooperating firms are visited upon completion of the analysis and shown how their costs compare with other firms. The items of cost are set up so that the individual organization can readily identify its efficient and inefficient practices.

Consumer preferences for citrus fruit are being studied as a means of discovering opportunities for expanding the market for citrus products. Housewives have been interviewed to obtain information on their likes and dislikes, and the extent and nature of the housewife's knowledge of citrus products. Information was obtained at the same time on consumer buying behavior in retail stores. Consumer preferences were analyzed on such items as: packaged fruit vs. bulk fruit; count vs. pound selling; large cans of juice vs. small; sweet vs. unsweetened juices; pink vs. white grapefruit; and pattern of buying of fresh fruit vs. canned products.

A study of peach marketing was made to compare the relative conditions and losses of firm-ripe and green-mature peaches transported to market in Spartan boxes, bushel baskets and cell containers. Special attention was given to firm tree-ripened peaches. Observations were made in the retail stores on consumer preference, and information was obtained on losses of the two degrees of ripeness of peaches.

A recent study was initiated on costs and margins for marketing the most important Texas fruits and vegetables in out-of-state markets. The purpose of this work is to measure the margins at each level of trade as a means of discovering opportunities of reducing both costs and margins.

Studies of livestock marketing under way include an analysis of livestock auction operations; comparisons of beef cattle prices by grades at the Fort Worth, Houston and San Antonio markets; comparisons of sheep and lamb prices by grades at the Fort Worth, Kansas City and San Antonio markets; and a study of the livestock marketing system in Texas, including slaughter, movements, marketing costs and governmental regulations.

Cotton marketing research has been focused on procedures and problems in the local market as related to the handling of the product. Special attention was given to the handling of one-variety cotton at the various local markets. It appears that marketing operations have not been readjusted to fit the needs of producers of high quality cotton. A study was initiated recently dealing with the storing of seed cotton as a measure of fitting the ginning business to changes in requirements arising from the mechanical harvesting of cotton.

LAND ECONOMICS

Land Market Studies

The primary objective of the study of the Texas farm land market has been to record changes in land prices and in volume of transfers through the war and postwar years; to analyze the impacts of the land market on achievement of ownership by farmers; and to relate changes in the land market to tenure trends.

Trends in land prices through the war and postwar years were obtained in 22 counties on an annual basis. Texas farm and ranch lands have more than doubled in price since 1941. Volume of sales increased significantly but did not double as prices have. Most land purchases have been for cash, but in those instances where credit was used, the amount has been proportionately large, and the source of credit has not been well suited to agricultural needs. It is expected that there will be difficulty in paying off many of these mortgages. Farmers have been the chief buyers of land throughout the period of study, indicating their strong financial position, and also their desire to obtain a stronger hold upon the land they operate.

Figure 1 shows the trends in land prices in relation to farm income, farm wages and prices paid by farmers, 1940-48.

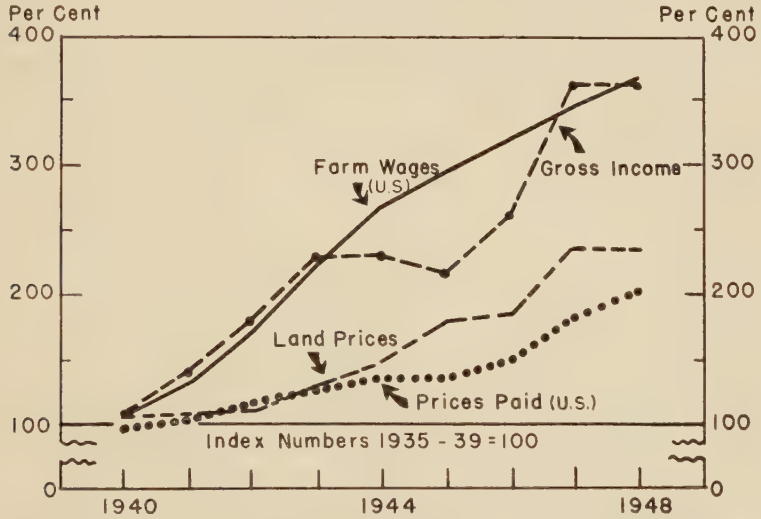

Figure 1. Trends in land prices, farm income, farm wage rates and prices paid by farmers, 1940-48.

Land Tenure Trends

The primary objectives of land tenure studies have been to analyze trends ln land ownership and farm leasing; to in-

terpret the significance of these trends; and to arrive at improved rental arrangements which can be adapted to Texas farm rental conditions.

Ownership trends have been considerably in favor of the owner-operator during the war and postwar period. Renting of farms has decreased significantly from one-half to one-third of all units. In renting, primary difficulties of arrangements still are related to the matter of security of the operator in his occupancy and operations. Most questions on rental arrangements involve the respective contributions to conservation practices of landlords and tenants. A large part of the rental problem at the present time stems from the lack of flexibility of customary leasing procedures in adapting to changing needs in technology and conservation.

Irrigated Agriculture in Texas

The primary purpose of this study, begun in 1949, is to inventory and analyze the importance of irrigated agriculture in the State.

Preliminary findings show that irrigation farming has grown to great importance in the State, with the acreage more than doubling since 1940. About 2,885,000 acres were irrigated in 1948. About 12 percent of the 1948 harvested acreage was irrigated. The value of irrigated crops will run considerably higher than their proportion to the total value of all crops.

The principal irrigated areas include the Lower Rio Grande Valley, the High Plains, the Trans-Pecos and the Coast Prairie. From the standpoint of acreage, the three leading crops irrigated in 1948 were cotton, 939,500 acres; grain sorghums, 566,600 acres; and rice, 525,000 acres.

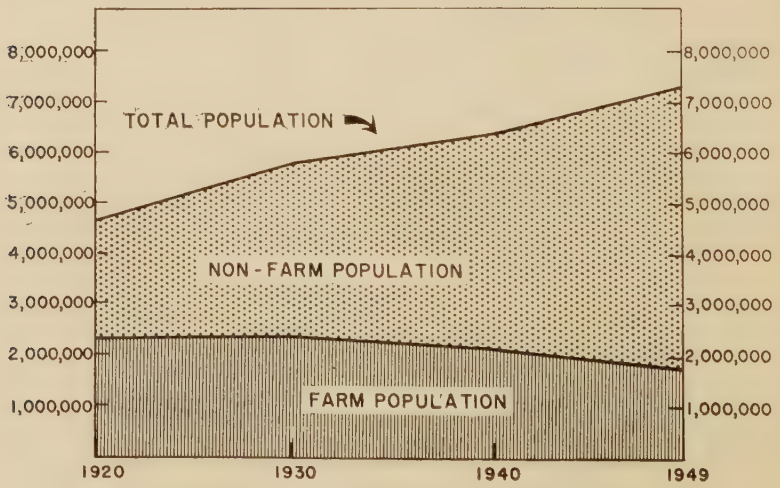

Figure 2. Trends in the Texas farm population, 1920-49.

Farm Population Studies

The primary objective of this study has been to maintain trend information for the farm portion of the total population. Figure 2 shows the trends in the Texas farm population 1920-49.

Rapid changes in technology and in non-farm opportunities during the past few years encouraged the flow of farm population to urban employment and living. The farm population decreased 438,000 from January 1, 1940 to January 1, 1949. The decrease in 1948 was 11,000. During the same period, the total population in Texas increased 979,000. The farm population was only 23 percent of the total population, as compared with 33 percent in 1940 and 49 percent in 1930.

AGRICULTURAL PRICES, POLICIES AND FINANCE

Agricultural Prices

Prices received during the period August 1909-April 1948 for agricultural commodities produced in Texas were summarized and published as monthly averages. These were also expressed as price relatives and were combined into groups to form price indexes, using the period August 1909-July 1914 as a base of 100.

Farm Taxation

Few industries are so directly affected by the property tax as agriculture. No farm enterprise can escape its burden, and

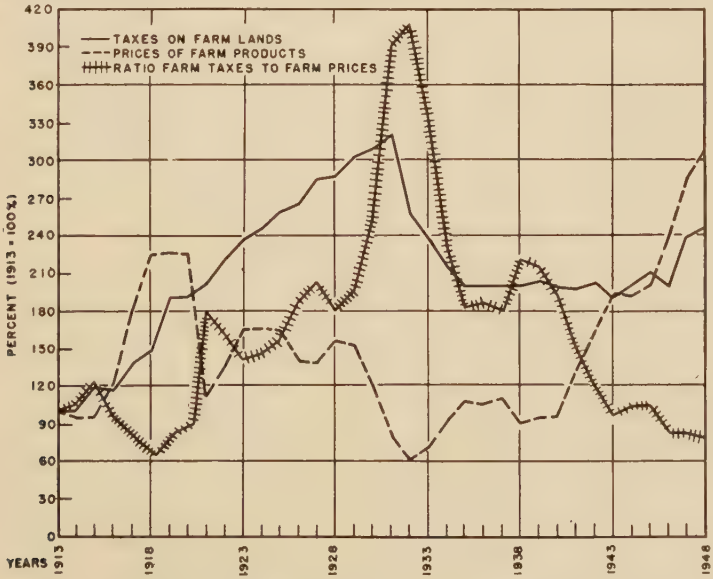

Figure 3. Trend of taxes on farm and ranch real estate in Texas as related to the prices of farm products, 1913-48.

all rural people are dependent on the roads, schools and other public services to which it contributes. It is an item that influences such important factors as land prices, production costs and land use. Reliable information about taxes and particular problems of local government is needed by farm people, public officials and agricultural workers. The Station's "trend of taxes" project illustrates the research done in this field, Figure 3.

Texas farm and ranch real estate taxes increased 19 percent in 1947, one of the sharpest rises of a record that goes back to 1890. The advance marked an abrupt deviation from a long period of stable taxes, 1936-46. Despite a lowered 1948 tax rate by the State, taxes advanced again, though moderately, indicating local taxes were still rising substantially.

The record of farm taxes reveals a tendency for levies to move in the same direction for long periods, often in the opposite direction to prices of farm products. When prices and taxes follow diverse movements, wide swings occur in the real burden of farm and ranch owners.

By providing basic data relating to local government and taxation, the Station serves rural people, public officials and agricultural workers in making agricultural and tax policy.

RURAL SOCIOLOGY

Rural Health

One of the research projects is the health problems and needs of Texas farm people. One progress report has been published on this study.

Findings thus far indicate that Texas rural people have a great many health problems and needs irrespective of the region in which they live. A few diseases are found more frequently in one region than in another. The study indicates the problems created by Texas having a public health department in only 54 of the 254 counties. The most important health needs at the present are in preventive measures and health education.

Rural Community Organization

Another project is a study of the social organization and operation of a rural community. This was published by the Department in two reports: "Rural Resources of the Caldwell Community," and "Opinions and Attitudes of Caldwell Community Leaders."

These reports had wide circulation among community workers in Texas and have received favorable comment from a great many quarters. The report, by stimulating interest in the local community in coordinating and guiding individuals, civic clubs and community agencies, resulted in a great many improvements, especially in creating more cooperation between the rural and urban people in developing improved agricultural programs.

Figure 4. A two-row tractor mounted cotton stripper harvesting "stormproof" cotton near Lubbock. Scarcity and high cost of labor at harvest time during recent years caused a large increase in the use of mechanical strippers on the High Plains of Texas.

Agricultural Engineering

MECHANIZATION

Cotton Mechanization

A study of cotton mechanization in Texas was begun in September 1947 as part of a belt-wide regional cotton mechanization project.

Cotton was both drilled and hill-dropped in 1948 with standard dropping mechanisms. The hill-dropped cotton was cultivated with the cultivator attachment type of rotary hoe in combination with the conventional sweep. The drilled cotton was thinned by hand, mechanical and flame methods. These plots were cultivated like the hill-dropped plots. Annual grasses were completely controlled because of the dry season. Perennial grasses and weeds had to be chopped back at least twice with the hoe.

Cotton was planted at Lubbock in deep and shallow-listed furrows to determine the effect of furrow depth on stands of cotton. The rotary hoe attachment was an excellent tool for breaking the soil crust resulting from rains a few days after

planting. Hoeing costs were reduced 60 percent where the rotary hoe was used in cultivation.

Cotton was harvested at College Station with a mechanical picker and at Lubbock with a mechanical stripper, Figures 4 and 5. Approximately 95 percent of the cotton was gathered

Figure 5. Harvesting a bale of cotton per hour with a mechanical picker. The yield was about 1.5 bales per acre on the Brazos River Valley Laboratory plots.

with the picker. Storm-resistant (storm-proof) cottons gave less field losses in stripping at Lubbock than did the normal boll types of cotton, Figure 10.

Defoliation of the cotton plants was helpful for harvesting cotton either by hand or by machine. New chemical defoliants are being tested.

Cleaning Mechanically-harvested Cotton

A study was begun in 1946 to determine the percentages of burs, stems, fine trash, dirt and sand in mechanically harvested cotton (picked and stripped) at early, midseason and late dates. The amount of foreign matter in cottons machine-stripped at Lubbock increased as the harvest was delayed. The grade of the cotton also dropped with later harvestings.

Deltapine 14, Mebane 140, Stoneville 2B and CA89A were used because of varietal differences, such as plant type, storm resistance and staple qualities.

Cotton was stripped at College Station on September 23, October 20 and November 24. Poor results were obtained from the application of defoliants on each of the three dates. Best results were obtained from the November harvest. More foreign matter was removed from the storm-resistant variety CA89A at the September harvest than from any of the other varieties. Higher percentages of foreign matter were removed from the normal-boll Deltapine for the harvests made October 20 and November 24. The average grade of the lint for CA89A was Good Ordinary, and for Deltapine it was Below Grade.

The grade of the cotton machine-picked October 2 was Low Middling for both CA89A and Deltapine. The grade for Mebane 140 and Stoneville 2B was Strict Good Ordinary. Less foreign matter was removed from the machine-picked cotton than from the machine-stripped cotton.

The four varieties were machine-stripped at Lubbock on November 5 and 26 and December 29. Good defoliation was obtained for the November 5 harvest. The November 26 and December 29 harvests were made after killing freezes had occurred.

DRYING AND STORING FARM CROPS

Artificial Drying

Sorghum grain. Tests were made in 1947 to obtain basic information on the drying and its effect on the milling characteristics of sorghum grain. A batch-type farm drier, designed and tested by agricultural engineers of the Texas Station, was used.

The drying cycle for Early Hegari and Martin consisted of at least two stages: the evaporation of surface moisture, and the diffusion of moisture from inside the kernel to the surface where it was absorbed by the air moving through the grain. The velocity of the air was an important consideration during the first stage as it governed the rate of drying. The drying rate during the second stage depended on the rate of diffusion. With the higher air temperatures, the rate of diffusion was high at first but became slower, with the drying rate falling off rapidly near the end. The ultimate time of drying was, therefore, governed by the rate of both surface moisture removal and diffusion.

The fastest rate of drying and the lowest costs for power and fuel were obtained when the velocity of the air through the grain column was 80 to 90 feet per minute. The most efficient air temperatures for drying the grain to 12 percent moisture was 150° F. for grain with 14 to 16 percent moisture; 175° F. for grain with a moisture range of 17 to 20 percent; and 200° F. for grain above 20 percent moisture.

The cost per ton for electric power and natural gas fuel was approximately 20 cents for grain with 14 to 16 percent moisture; 25 cents for 17 to 20 percent moisture grain; and 40 cents for grain with 21 to 24 percent moisture.

The wet-milling characteristics of the grain were not impaired by artificial drying to 11 to 13 percent moisture content with air temperatures of 125° to 200° F.

Rice. Tests to determine the effect of air temperature and the initial moisture content on the germination and milling quality of rice when dried in sacks have been made at the Beaumont station since 1947. Tests have been made with Bluebonnet, Patna and Rexoro varieties.

Results of these tests show that the following air temperatures (F.) can be used without detrimental effect on germination: 140° for rice with 15 percent moisture or lower; 125° for a moisture range of 15 to 20 percent; and 120° for a moisture content above 20 percent. To obtain high milling yields of head rice, the following air temperatures (F.) should be used: 125° for rice with 15 percent moisture or lower; 115° for rice with 15 to 20 percent moisture; and 105° for rice above 20 percent moisture.

Peanuts. Tests at the Stephenville station and at farm installations during the past 4 years show that peanuts can be dried successfully in sacks and in bulk. Either a barn drier

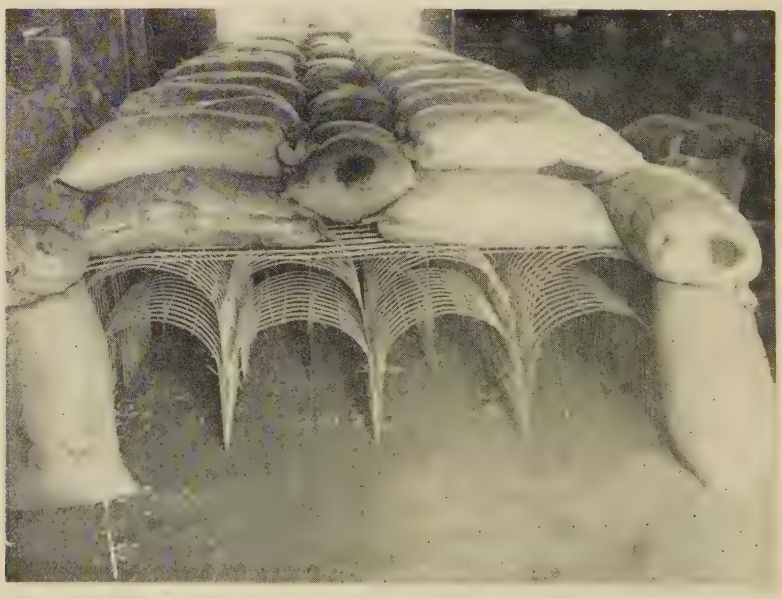

Figure 6. Method of stacking sacks of peanuts around a portable air distribution system.

or a portable air distribution system can be used for drying peanuts in sacks.

A sub-floor design proved to be the best type of barn drier. This consists of a slatted floor raised 24 to 30 inches off the ground or barn floor. The space between the two floors is made airtight and serves as the air distribution system. Heated air is forced into this airtight chamber and through the sacks of peanuts stacked on the sub-floor. Costs of fuel and power averaged 85 cents per ton, dry basis, when drying peanuts from 18 to 8 percent moisture.

The portable air distribution system used consisted of a removable tunnel placed on the ground or barn floor. The tunnel was made of 2-foot length sections of heavy welded wire mesh. (A tunnel constructed of wood would serve the same purpose.) The peanuts were stacked around the tunnel and heated air forced through the sacks to remove the excess moisture, Figure 6. Peanuts were dried at a cost of 80 cents per ton, dry basis, for fuel and power when the moisture was reduced from 13 to 8 percent. The success with this method was determined largely by the manner in which the sacks were stacked around the tunnel. To obtain uniform drying, the sacks should be stacked so that the air will pass through the thickness of only one sack in all parts of the stack.

Tests were also made with a small column-type drier at the Stephenville station to determine the maximum width column that could be used and still obtain uniform drying throughout the column. Based on the results of these tests, a maximum width of 16 inches is recommended for this method of drying peanuts.

Peanuts were dried with air temperatures ranging from 112° to 150° F. It was found that there was no significant reduction in germination if the air temperature did not exceed 135° F.

Baled hay. About 688 bales of alfalfa hay were dried in 6 tests in 1948. Partially-cured hay was baled and drying finished by forcing heated air through stacks of bales. The drying time varied from 13 to 37 hours, depending on the method of stacking and the moisture content of the hay when baled. The cost of fuel and power ranged from $3.13 to $6.53 per ton.

Chopped hay. Sixteen tons of alfalfa and mived feterita and Johnson grass were dried in 1948 with a portable rotary drum dehydrator. The capacity of the drier varied directly with the moisture content of the crop being dried. The dehydrator evaporated approximately 1,500 pounds of water per hour from wet alfalfa when it was chopped into about three-eighths-inch lengths. A fifth cutting of alfalfa, dehydrated before it began to bloom, contained 276 parts per million of

carotene. The same hay after 2 days of sun curing contained only 42 p.p.m. of carotene.

A series of tests were conducted in 1949 on drying chopped alfalfa hay with a portable drying unit and a modified farm trailer, Figure 7. Heated air was supplied by a commercial

Figure 7. Portable drier and farm trailer method of drying chopped hay.

portable-type drier designed for farm drying installations. The unit, mounted on wheels, contained the fan, power unit, burner and temperature controls. The trailer was an ordinary four-wheel, farm-type trailer, 7 by 14 feet, with wire mesh sides and a wire air duct added to handle the chopped hay. The hay was allowed to cure in the field until the leaves were almost ready to shatter. This varied from 2 to 6 hours, depending on the climatic conditions. The hay was chopped and blown into the trailer by a forage harvester. The drier unit was then attached to the loaded wagon and the hay dried to about 20 percent moisture content.

The most desirable air temperature was 145° to 150° F. Higher temperatures wasted heat and increased drying costs. The portable drier and farm trailer method dried three-fourths ton of alfalfa per hour from 45 percent moisture content (shattering stage) to a safe storage level at a fuel and power cost of $1.12 per ton. Labor requirements were about the same as for a normal baling crew.

Resistance of sorghum grain to air flow. Tests were made

at 1, 2, 3, 4 and 5-foot depths to determine the relation of the depth of grain to the static pressure and volume of air. An increase in the volume of air for a given depth of grain caused an increase in static pressure in a greater proportion than the increase in air.

Storage

Sorghum grain. Tests were started at the Beeville station in 1948 to determine the feasibility of on-the-farm storage of sorghum grain in South Texas, Figure 8.

Figure 8. Experimental bins used to determine the feasibility of on-the-farm storage of sorghum grain.

Thirteen storage bins and five underground pits were filled with the Martin variety in July 1949. Seven of the bins were constructed of steel, four of wood and two of temporary construction. Some of the bins were painted white and some aluminum to determine the effect of the color of the bin wall on the temperature of the grain. Thermocouples were installed in each bin and temperature observations made at regular intervals during the storage period. Controlled measures against insects are also being studied.

Results after 8 months of storage indicate that a moisture content of 12 to 14 percent is too high for safe storage. There has been no apparent reduction in germination of grain stored with a moisture content of 10 to 12 percent. It is obvious from these tests, however, that grain temperatures from 100°

to 110° F. over a long period have a detrimental effect on the germination of the seed. It also is apparent that insects can be controlled more effectively when the moisture content does not exceed 10 to 12 percent.

Chopped hay. Tests were started in 1949 to determine the practicability of using chemicals to prevent spoilage of partially field-cured hay. Several tests with different rates of application were made with hay at various stages of dryness. Results show that the chemical used will not prevent spoilage of hay above 60 percent moisture. There is a possibility that it may prove satisfactory for hay containing 35 to 40 percent moisture. Additional research is needed before definite conclusions can be made.

Storage of cotton seed for planting purposes. Tests are under way to determine the conditions necessary for the safe storage of cotton seed for planting purposes.

A small building containing six experimental bins each holding two tons of seed was constructed. The bins have sub-floors for drawing air through the seed and thermocouple connections for measuring the temperature of the stored seed at regular intervals. Two large steel storage tanks, each holding 180 tons of cotton seed, have thermocouples so that the temperature of the stored seed may be taken at regular intervals during storage at 20 different locations in each bin.

In general, it was found that freshly ginned cotton seed should be checked closely for damaged seed before storage. Only those seed showing no field damage due to wet weather and containing less than 12 percent moisture should be stored, unless facilities are available for drying the seed before heating or enzyme activity causes a loss in viability.

Resistance of cotton seed to air flow. Tests were made in 1949 to determine the resistance to air flow of linted and delinted cotton seed. Deltapine cotton seed was used.

One test was made with linted seed 8 feet deep. The volume of air varied from a minimum of 4.68 cubic feet per minute per square foot of floor area to a maximum of 26.03 CFM. This procedure was the same for delinted seed, except that the seed were 4 feet deep and the volume of air varied from 6.57 to 40.74 CFM per square foot of floor area.

These tests indicate that the aeration of cotton seed should be confined to low volumes of air (4 to 10 CFM per square foot of floor area). The large decrease in volume and the small difference between the resistance of linted and delinted seed to air flow at volumes below 10 CFM per square foot of floor area indicated that delinting would be profitable.

FARM ELECTRIFICATION

Farm Refrigeration

Research on the development of an "all-purpose" or dual-temperature farm refrigerator was reinstated in 1948 after a lapse during the war. This refrigerator will be designed primarily for cooling, freezing and storing the farm food supply, and for relatively small quantities of perishable products to be sold. It will have a walk-in chill room of 150 to 400 cubic feet capacity and a freezer compartment of 25 to 150 cubic feet. The chill room will be operated at 35-36° F. and the freezer compartment at 0° F.

A survey was made during December 1948 and January 1949 of 55 "all-purpose" refrigerators in use on Texas farms, ranches and country estates to determine the size and dimensions of the storage compartments, the type of construction and the amount of insulation used, the amount and kinds of food stored and other essential information on construction and operation. Its purpose was to develop information which would be useful in establishing specifications for an "all-purpose" refrigerator for general farm use.

An insulated refrigerator testing room was built in 1949 in the agricultural engineering laboratory. Inside dimensions are approximately 16 feet wide, 24 feet long and 11 feet high. Refrigeration, heating and humidity control equipment is being installed so that any desired atmospheric condition between 10° and 110° F., and 40 and 100 percent relative humidity may be maintained. This room will be used to determine the mechanical performance of experimental refrigerators under various ambient and load conditions.

Records have been kept on the operation of various sizes and types of food freezer storage units in 60 Texas farm homes. Separate electric meters were installed to measure the amount of electricity used by each of these units. These meters are read each month for 12 consecutive months. Farm owners have kept records of the amounts of various foods stored and the time at which the food was placed in storage. These records are being analyzed to determine the factors affecting cost of operation, the amounts of various kinds of food commonly stored, the length of the storage period, quality of the food at the end of the storage period and the amount of storage space used.

Milk Pasteurizers

Among the many postwar developments of electric equipment for home use is the small electric milk pasteurizer. Several types are being developed, ranging in capacity from $\frac{1}{2}$ to 3 or 4 gallons. Laboratory tests were made during 1947

on two of the units to determine the electricity used, rate of heating under various conditions, uniformity of temperature in the milk, rate of cooling, effectiveness of pasteurization and the effect on the flavor of the milk. Both units provided effective bacteria "kill" with no objectionable effect on the flavor of the milk. The electricity required for pasteurization varied from .39 to .68 Kwh per gallon of milk, depending on the initial temperature of the water and milk.

Another postwar development is the all-electric milk pasteurizer for use in commercial milk processing plants. The milk passing between two electrodes serves as a conductor of electricity. Heat for pasteurization is generated as a result of the resistance of the milk to the flow of electricity.

These pasteurizers vary in size from 1,300 to 10,000 pounds of milk per hour. The electrical demand of the units varies from 13 to 65 Kwh. One of these units was installed at the Lamar Creamery in Paris in 1948. A recording electric demand meter was installed on this unit. A continuous record of 1 year has just been completed. This shows the quantity and duration of the electrical demand. A continuous record was also kept of the total electrical demand of the entire milk processing plant. An analysis of these two demands is now being made to determine the amount of electricity used by the pasteurizer and the effect of the "demand" on the electric rate applicable to this type of equipment. A record has also been kept of the total amount of milk pasteurized and the efficiency of pasteurization.

Grinding Feed With Electric Power

A study of the use of electric motors for operating feed grinders on Texas farms was continued during 1947-48. Laboratory tests were made on five mills requiring from 1 to 5 horsepower motors. Tests were made to determine the power requirements and rate of grinding with each of the mills when grinding shelled corn, threshed grain sorghum, wheat, oats, barley, snapped corn and grain sorghum bundles. These tests indicate that electric motors of $7\frac{1}{2}$ H. P., or less, will provide ample power for all grinding needs, except on farms where very large feeding operations are carried on.

When grinding grains which can be fed into the mill automatically, the small-powered units, such as 1 H. P., are satisfactory even where 300 or more cattle are being fed. When grinding the roughage feeds, such as snapped corn and grain sorghum bundles which cannot be fed automatically, the 5 H. P. units are probably the most practical.

The cost of power for grinding with electric motors was 10 to 15 cents per ton for grain, and 20 to 40 cents per ton for roughages.

Stock Tank Heaters

Records were kept during January, February and March 1949 on the operation of electric heaters for warming the drinking water for cows at two dairies near Houston.

An immersion type heater was used at one dairy in a metal water trough of 187 gallons capacity to heat water for 100 cows, 80 of which were producing milk. The trough was open at the top and was uninsulated. The water was kept at an average temperature of 55°. A total of 885 Kwh of electricity was used during the 3 months. At 2 cents per Kwh, this cost was $17.70. The operator estimated that his net saving, due to the prevention of decreased milk production during cold weather, was more than $200.

An immersion type electric heater was used at the other dairy in a 37-gallon cement watering trough for 180 cows, 60 of which were in milk production. During an 80-day period beginning January 10, this heater used a total of 1081 Kwh of electricity. This dairyman estimated his net saving during this period was $218.60.

Electric Hotbeds

Three different types of electric equipment were used to provide heat for the growth of early tomato plants in hotbeds.

Two 1350-watt fan-type electric heaters were used to supply heat in one 8 by 42-foot hotbed. These heaters were suspended above the plants and so located as to provide uniform temperature throughout the bed. The cover for this bed was a double layer of cheesecloth. A 10-ounce duck tarp was used over the cheesecloth on the coldest days and during rainy weather. During a 43-day period beginning February 11, 1947, this equipment used a total of 102 Kwh of electricity. The total cost of the electricity was $2.55, or approximately 16 cents per 100 plants produced. The total cost of the electric equipment, including heaters, thermostats and wiring, was $40.80.

A lead and plastic-covered soil heating cable was used in 1948 and 1949 to supply heat for growing tomato plants in hotbeds at the College horticulture farm. This cable was buried about 4 inches in the soil and spaced laterally to provide 5.7 watts per square foot of bed area. The seed were planted with greater than normal spacing (27 plants per square foot) so that the plants could be "hardened off" in the hotbeds without the necessity of transferring to cold frames. With this wide spacing, only 1.2 Kwh of electricity were required to produce 100 plants. All plants in the unheated beds were killed March 11-12, 1948, when the atmospheric temperature dropped to a minimum of 20° F. each day. Tomatoes from the plants produced in the electrically heated hotbeds produced a gross re-

turn of $1,000 per acre, largely because no other tomatoes were available for market at the time.

The lead and plastic-covered cable was used in 1949 to supply heat in hotbeds for producing early sweet potato plants. Plants in the electrically-heated bed were ready for transfer to the field 2 weeks earlier than those in an unheated bed. The total production of plants in the heated bed was approximately twice that in the unheated bed. The electricity required was 3.5 Kwh per 100 plants.

Incandescent lamps were used in January and February 1949 as a source of heat for producing early tomato plants on two farms near Jacksonville. In these installations, 200-watt lamps were suspended approximately 20 inches above the soil and spaced at intervals of 3 feet along the length of the bed. This provided approximately 8 watts per 2 square foot of bed area. A total of 1,026,000 plants were produced at a cost for electricity of only 1.2 cents per 100 plants.

The operation of two electrically-heated hotbeds in the vicinity of Houston was compared during December 1948 and January 1949, with that of a manure-heated bed and that of a flue-heated bed. These beds were used to produce tomato, eggplant and pepper plants. The cost of electricity in the electrically-heated beds was 7 cents per 100 plants. Approximately 75 percent of the plants in the manure-heated beds were lost because of insufficient heat and a high incidence of "damping off." The rate of growth in the flue-heated bed was not uniform. All plants in a strip 8 inches wide, immediately over the flue, were killed by excessive heat.

The electric beds required less labor, produced better plants and operated at a lower over-all cost than the other beds.

Figure 9. Two rows of a promising experimental corn hybrid. Notice the ability of this hybrid to stand well, while most hybrids in this test had high percentages of lodged plants.

Agronomy

FIELD CROPS

Barley

Barley improvement work to develop varieties adapted to the various climatic conditions of Texas is centered at College Station, Denton and Amarillo. Yield tests are conducted with a number of the more advanced strains at the Greenville, Iowa Park, Chillicothe, Beeville, Weslaco, Winter Haven and Temple stations, and in an outlying test at Comfort.

The Texas commercial barley acreage is largely made up of Wintex, Texan and Tunis, although there is a limited acreage of the very winter-hardy varieties, Reno and Ward, in the High Plains.

On the basis of yield trials of recent years, two new barley strains are in prospect, although neither has been named.

A mildew-resistant strain developed from the cross of Wintex x Texan has produced outstanding yields in North-central Texas. It probably will be released to replace Wintex, which is often damaged by mildew in that area. This selection, No.

8-43-311, has outyielded both parents and is as winter-hardy as Wintex. It is smooth awned like the Texan parent.

Another new barley strain, Selection 119 of the composite cross (Dryland x Peatland) x (Juliaea x Peatland) is promising for extreme South Texas. Its resistance to net blotch, leaf rust and stem rust is of major importance in South Texas. The rapid early season growth of Selection 119 is valuable for fall grazing but makes it very susceptible to injury by low temperatures.

Castor Beans

Yields of clean castor beans of the Conner variety at the Chillicothe station during recent years have varied from 1,219 pounds per acre in the high-rainfall season of 1941 to 666 pounds in 1949 when drouth prevailed during July and August. The average yield for the past 5 years grown was 909 pounds per acre.

Castor beans are well adapted to the Rolling Plains. Diseases and insects are not a problem and yields have been high enough for profitable production.

Cotton and castor beans can complement one another so as not to compete for labor at harvest time.

It is estimated that the beans from 500,000 acres in the United States could be disposed of profitably in the manufacture of paint, varnish, lacquer, linoleum and numerous other products.

Corn

The acreage planted to corn hybrids in Texas has expanded each year since 1941 when the first hybrid developed by the Texas Station was released. About 1,500,000 acres of the total Texas corn crop were planted to hybrids in 1949. Texas hybrids have produced from 20 to 30 percent more than the best open-pollinated varieties in yield test conducted at representative locations over the State.

Corn hybrid and variety performance tests are now being conducted at 17 widely-scattered locations. These are College Station; the Temple, Greenville, Denton, Tyler, Beeville, Stephenville and Chillicothe stations; and outlying tests at Lockhart, Brenham, Holland, Mart, Garland, Paris, Gatesville, Cleveland and Nacogdoches.

The performance of the new yellow hybrids, Texas 24, 26 and 28, indicates that they may be recommended for all areas of the State where the older recommended hybrids are now grown successfully. These new hybrids may generally be expected to produce from 5 to 10 percent more corn than the other hybrids now available. Texas 26 and 28 were first or

second in practically every location where they were grown during the past 3 years. Texas 24 also was near the top in all tests where it was included. Texas 28 appears to be the most widely adapted of the new hybrids.

Texas 26 and 28 are particularly recommended for the Blackland Prairie and the western corn-growing regions of the State. They also may be expected to perform well under conditions of severe drouth. Texas 20 and 28 are recommended for East Texas. Of the white hybrids, Texas 11W has consistently produced higher yields than 9W, and is generally recommended where white corn is planted.

Texas 24 is strongly recommended for several characteristics other than yield. It was definitely superior to the other hybrids in resistance to root lodging in the 1949 tests and, along with Texas 28, had less stalk breakage. Texas 24 also had less damage by earworms and had fewer unsound ears than the other yellow hybrids. Texas 20 and 26 had the highest shelling percentages of the Texas yellow hybrids, although all hybrids have a substantially higher shelling percentage than the open-pollinated varieties. Texas 26 is the earliest of the new hybrids, while Texas 28 is slightly later than any of the Texas hybrids now in production.

Approximately 2,000 acres of Texas 24, 26 and 28 were produced by certified seed growers in 1949. Farmers will be able to plant a considerable acreage to these hybrids in 1950.

Results of preliminary tests indicate that some of the experimental hybrids now under test are superior in resistance to lodging, Figure 9, and at least equal or better in yield than present hybrids. Some are also much more resistant to insects and diseases. Improved hybrids capable of replacing those now in production shou'd, therefore, be available within the next few years.

In making a choice of hybrids, farmers and dealers should select those that have given the best results in tests representing their region. The average results for a 3-year period are more reliable than those for any one year, and should be used whenever possible as a basis for selecting hybrids. In particular, the new hybrids that have proved their superiority to the older hybrids should be tried out.

Cotton

Beasley Laboratory. A laboratory and two attached greenhouses were constructed at College Station in 1949 to provide facilities for basic research on live cotton plants the year round. These have been named the Beasley Laboratory in memory of the late Dr. James Otis Beasley who, as a member of the Texas Station staff, initiated many of the lines of research about

which the present program has been built. The laboratory was formally dedicated November 3, 1949.

Cotton breeding. Many plant breeders feel that the maximum development to be obtained through selection within current varieties of American Upland cotton has been about reached. Future progress is dependent on the skill of the breeder and on the inherent variability of his stocks—the desired characters must be present somewhere or produced somehow before they can be used as breeding material. Tremendous variability, quite outside the range of that present in cultivated upland cottons, exists in the wild and native types of the genus *Gossypium*. Many valuable characters not present in current varieties are known to be carried in certain of these noncommercial cottons, and many other valuable characters await discovery.

Contacts have been established with cotton research stations and botanical institutions over the world to obtain seeds of all available taxonomic species. Live specimens of 16 of the 18 or 20 recognized *Gossypium* species have been established in the Station greenhouses. Steps are being taken to complete the collection and obtain additional specimens to represent the range of variability of all the major groups. Extensive collections of native cottons have been made in Southern Mexico, Guatemala and San Salvador during the past 3 years by members of our staff. The presumed center of origin of American Upland cotton lies within this area. The 303 stocks collected in 1946 and 1947 and 338 stocks collected in 1948 have been added to the collection of cottons at College Station.

Plantings made from the 1946 collection showed that many of the stocks do not flower during the long summer days in the latitude of College Station, and more than 50 percent of the stocks failed to mature seeds in the field before frost. The types which set fruit are being grown at College Station, and are being evaluated for fiber properties, earliness, boll size and other agronomic characters, as well as for disease, insect and drouth resistance.

Selected stocks which do not fruit in the temperate zone are being grown in the tropics under cooperative arrangements with the U. S. Department of Agriculture's field station at Mayaguez, Puerto Rico, and Harvard University's Atkins Garden in Cuba. Two members of the staff gathered information on these plantings in May 1949.

A new trispecies hybrid of cotton, which combines an American wild cotton, *Gossypium harknessii*, with Asiatic and American cultivated species, has been obtained. The new hybrid is similar in chromosome constitution, although not in mode of origin, to the *thurberi* trispecies hybrid which is being used

extensively in our cotton improvement program. The *thurberi* hybrid was obtained by first crossing as Asiatic species, *G. arboreum*, with *G. thurberi*, then doubling the chromosome number of the first-generation hybrid with colchicine. The value of this hybrid lies in its chromosome constitution $2(A_1D_1)$, which is similar to the chromosome constitution $2(AD)$ of our cultivated cotton. Crossing the synthesized with the natural amphidiploid produced the original trispecies hybrid.

The new trispecies hybrid was obtained in another manner. The cross *G. arboreum* x *G. harknessii*, combining the A_2 and D_2 genomes or chromosome sets, has not been obtained directly. However, by using as one parent a hybrid of *G. hirsutum* x *G. arboreum*, transformed into a hexaploid by colchicine treatment, and crossing it with the American wild species *G. harknessii*, a trispecies hybrid combining all three species is obtained in one step. The chromosome constitution includes the $(AD)_1$, A_2 and D_2 genomes.

G. harknessii, a species not heretofore used in cotton breeding programs, has several characters of potential value in developing better cottons. Among these are the small, deciduous

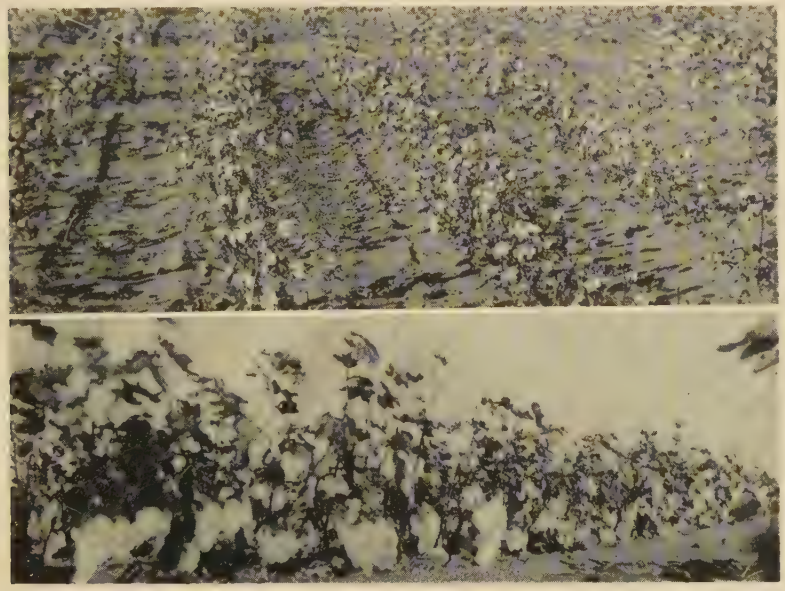

Figure 10. Upper—Cotton bred at the Lubbock station for mechanical harvesting. Notice the height of the fruit from the ground and the "stormproof" boll type. Combined weather and stripping losses at Lubbock for this cotton usually range from 2 to 6 percent. Lower—Not "stormproof" type of cotton. Notice the fruit close to the ground and stringing out. Combined weather and stripping losses at Lubbock for this cotton usually range from 11 to 21 percent.

bracteole and the smooth, almost entire leaf. Any of these characters would reduce the amount of trash in the lint. Another character is the type of waxy covering on the lint, which may contribute special spinning properties to the fiber. The new trispecies hybrid has been backcrossed with our cultivated varieties to obtain segregates from which some of these characteristics may be recovered.

Still another trispecies hybrid, which combines a third American wild species, *G. raimondii,* with *G. hirsutum* and a wild species from India, has been obtained. In addition, a hybrid combining the chromosome sets A_2, D_1 and D_2 has been obtained. Each of the three new hybrids represents the combination in the presence of a third species of two species which cannot be crossed directly.

The recovery of segregates with fibers of high strength from the trispecies hybrid involving the practically fiberless species *G. thurberi,* suggests that, with careful selection, other as yet undetected fiber types may be uncovered, as well as other characters of potential value in our cotton improvement program.

Testing cotton varieties. The cotton variety testing program was revised in 1948 to set up a more standardized and comprehensive system of testing varieties and newly introduced strains on a statewide and regional basis.

The State has been divided into three regions. Region 1 is the irrigated region, including the substations at Weslaco, Ysleta and Balmorhea, as well as tests at Lubbock and Iowa Park. Region 2 is West Texas (Rolling and High Plains), including the substations at Chillicothe, Iowa Park, Spur and Lubbock, and the U. S. Field Station at Big Spring. Region 3 is the remainder of the State, including the substations at Beeville, Tyler, Temple, Denton, College Station (Main Station Farm and Brazos River Valley Laboratory), and the U. S. Cotton Field Station at Greenville. In addition, several outfield tests are being conducted in Nueces, Wharton, Willacy, Hidalgo and Cameron counties.

Two types of tests are underway. One is a regional standard test of 16 widely grown varieties which remain unchanged in the test for 3 years. The other is a supplemental test, which may vary as to entries from year to year and from station to station, to provide the local testing of new strains and to serve as a proving ground for varieties and strains which may later be included in the regional standard test.

A report of varietal performance will be made at the end of each third year. Progress reports are made each year from most of the stations at which these tests are conducted.

A large number of commercial varieties and strains were compared with one another and with recently developed selections and hybrid strains from the breeding blocks of the Texas Station, and from the blocks of commercial breeders over the Cotton Belt. Information from the cotton variety tests, together with the reports of the cooperative fiber and spinning and oil milling tests made at College Station, are being used in the cotton quality improvement program which is making rapid progress in the State.

Flax

The proved flax area in Texas is roughly a triangle extending from San Antonio east to Houston and south to Brownsville. Over 2 million acres in this triangle are well suited for flax production. Flax is a relatively new cash crop in this area and is grown principally for seed for the production of linseed oil and meal. Harvestings increased from 1,000 acres in 1938 to 273,000 acres in 1949. The 1949 crop brought South Texas farmers an income of over 6 million dollars.

Flax seed are usually scarce and prices near a peak in May when the Texas crop is marketed. This is 3 or 4 months ahead of the harvest in the Dakotas and Minnesota.

Flax isn't choosey as to soil; however, as with most crops, the best yields usually come from fertile fields that are reasonably free of weeds. Any good farm land ranging from loams to heavy blacklands are well suited for flax. Sandy soils are not desirable due to the hazards of soil blowing. If possible, the land should be plowed 6 to 8 weeks before planting and kept free from weeds. This gives ample time for the soil to settle and provide a firm seedbed. The crop is usually planted in late November; however, depending on moisture conditions, the planting date may range from mid-October to late December. The usual rate of seeding is 25 to 30 pounds per acre drilled about one-half inch deep. Up to 200 pounds per acre of a 6-12-0 or 10-10-0 fertilizer mixture have been applied at planting time with good results in seasons of average or above average rainfall.

The two varieties most widely grown in South Texas are B-5128 and Golden. Both are resistant to rust and wilt. The Texas Station has produced a third variety, Turkey Winter, that branches freely, grows low during the winter and is moderately late in maturity. This new winter hardy variety has extended the Texas flax area 200 to 300 miles farther north.

A number of new, promising selections are being tested at College Station, at the Beeville and Winter Haven stations, and in an outlying test at Kenedy. All breeding work is designed to select or develop varieties with more resistance to rust and

pasmo, and to combine disease resistance with the low temperature resistance of Turkey Winter and Roman Winter.

Oats

Oat improvement work has been materially expanded in recent years in an attempt to develop new varieties better suited to grain production and winter pasture under the various climatic conditions of Texas. The major breeding program is carried on at Denton and College Station, with cooperative yields testing and disease or winter-hardiness studies at the Chillicothe, Iowa Park, Spur, Temple, Stephenville, Beeville, Winter Haven, Weslaco, Angleton and Greenville stations, and in an outlying test at Comfort.

Red Rustproof oats continue to occupy most of the acreage in the State. New Nortex, developed in this improvement program, is the most popular variety. Fultex is grown extensively in the Rolling Plains where Helminthosporium blight is of minor importance. Most of the oat acreage in Texas is fall-sown and winter-killing of several hundred thousand acres in each of the past three seasons caused a major loss in farm income. Oats offer a practical and economical source of winter pasture in South and Central Texas, but are often seriously damaged by crown rust, stem rust and Helminthosporium blight. Research to develop a more winter-hardy oat for North-

Figure 11. Mustang (right), a new disease-resistant, winter-hardy oat variety, which survived the severe winters of 1946-47 and 1947-48, at Denton when commercial varieties (left and rear) were killed or seriously damaged.

central Texas has been underway for many years. A partial attainment of this goal will be reached with the distribution of the new variety Mustang in 1950.

This new variety is approximately 20 percent more winter-hardy than the Red Rustproof oats. It survived the severe winters of 1943, 1947 and 1948 when most varieties were killed or seriously injured by low temperatures, Figure 11. Mustang is resistant to crown (leaf) rust but is susceptible to stem rust and moderately susceptible to Helminthosporium blight. It is well suited to winter grazing, producing less early fall pasture than some strains but an abundance of pasture in midwinter and early spring, if conditions are favorable.

Mustang has yielded well throughout the State from fall seeding and also yielded well from spring seeding in North-Central Texas. It stands well for combine harvesting and matures earlier than Red Rustproof. The seed is gray in color.

Extensive breeding and testing work is under way to obtain other winter-hardy oat strains with even greater disease resistance than Mustang. Yield tests of new disease-resistant strains, developed by crossing the best commercial varieties with spring oat varieties resistant to the stem rust, are under way at several locations in South Texas. The adaptation of these new strains for grain and winter pasture is being studied.

Peanuts

Texas ranks second among the states in normal peanut acreage with an average of 685,200 acres during 1940-49. As far as climate is concerned, they may be grown in most parts of the State.

The principal peanut-producing areas in Texas are the West Cross Timbers, which lies west and southwest of Fort Worth; the South Texas area, south of San Antonio; and the Houston area, including Harris, Waller and Fort Bend counties. Peanuts, however, are grown to some extent throughout the eastern part of the State.

Of the several commercial varieties of peanuts, the White Spanish or improved strains of White Spanish are practically the only ones grown for commercial production in Texas. These varieties are used for shelling and for the manufacture of oil because of their flavor and high oil content. Spantex, a new variety developed in Texas, is one of the best. A limited amount of seed of Spantex should be available to farmers from certified growers in 1950 and larger quantities in 1951. Enough seed of Spantex should be available after 1951 to supply the demand. Spantex had a considerably higher germination at the Stephenville station and produced higher yields of nuts than commercial Spanish.

Peanut breeding work at the Stephenville station seeks to develop new varieties having disease resistance, high yield, uniformity in shape and size of pods, and other desirable characteristics. Many strains and varieties have been collected from over the world. They are planted in observation plots before being used as breeding material, or discarded, Figure 12.

Figure 12. Peanut observation plots at the Stephenville station. It is determined on these plots whether the varieties have characteristics that would make them suitable for breeding purposes.

Since the commercial production of peanuts in Texas is restricted to the small Spanish strains, these are always used as one of the parents in the various crosses and backcrosses. The first successful crosses made at the Stephenville station are in the second generation. Many additional crosses were made during 1949.

Rice

One of the main objectives of the rice varietal improvement program has been to develop a series of long, slender-grain varieties of early, mid-season and late maturity. These varieties mature in about 120, 145 and 170 days, respectively.

Texas rice growers divide their acreage among varieties of each maturity so as to make more efficient use of irrigation water and machinery.

Over 75 percent of the 1949 Texas rice acreage was sown to Rexoro, Bluebonnet and Texas Patna, the three leading long,

slender-grain varieties. This percentage would have been even higher if the industry had an early maturing, long slender-grain variety.

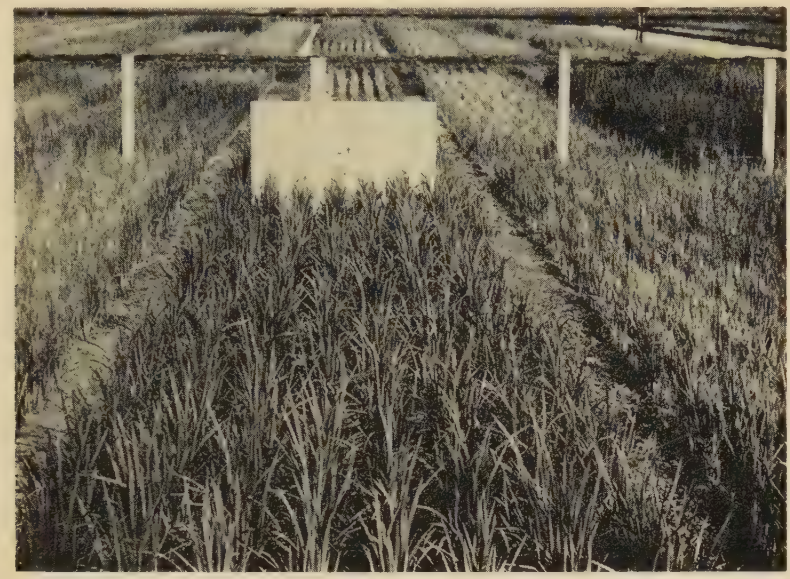

Figure 13. Fertilizer rate and ratio test plots with Rexoro rice at the Beaumont station. The picture was taken about 6 weeks after planting.

The Beaumont station has developed Century Patna, an early maturing, long, slender-grain variety, from a cross between Texas Patna and an early maturing Rexoro x Blue Rose selection. Over 500 barrels of seed are available for wide-scale field testing in 1950. This variety matures in 110-120 days and has shorter straw than any now grown in Texas. Century Patna was grown in 1949 in field tests in six counties and looked promising at each location.

Other long, slender-grain varieties of mid-season and late maturity also appear promising as possible improvements over Bluebonnet and Rexoro.

The Beaumont station has developed a foundation seed increase program which is now serving Texas rice growers. Foundation seed of Bluebonnet, Rexoro, RN (C.I.8975) and two unnamed experimental varieties, in addition to Century Patna, were released to growers in six counties to increase pure seed. More than 1,100 barrels of such seed were produced.

The Beaumont station will assist in supervising the cleaning, treating and allocation of most of this seed to insure a more equitable distribution over the rice-growing area.

Sorghum

Sorghum research covers breeding and improvement, inheritance and genetic studies, possibilities and methods of hybrid production, and field trials throughout the State with new strains and varieties, and with agronomic production and cultural practices.

Studies on genetics and inheritance are on the heritability of plant height, maturity or duration of growth, dry headstem, length of peduncle and various male steriles. All are economic characters of much importance in breeding for adaptation to modern harvesting machinery and for the practical production of hybrid sorghum.

Plant breeding and improvement, expanded 6 years ago to accomplish some specific objectives, is beginning to bear fruit in new varieties and types of special adaptations and uses. Several of these are now being released to farmers and growers. One is Combine Kafir-60, Figure 14, which was developed from a double dwarf strain backcrossed to Texas Blackhul kafir until it was a pure Blackhul kafir type. This new variety is adapted to combine harvesting, stands up well in the field, has partially dry head-stem characters, high yield and relatively early maturity. It blooms within 60 days after planting.

Two new red-seeded combine varieties—Redbine-60 and Redbine-66—are also being released. Both have better seed color than Martin and longer peduncle and better threshing than Plainsman. Redbine-60, which blooms in 60 days at Lubbock, is a little earlier than Martin. Redbine-66 blooms in 66 days and is a few days earlier than Plainsman. Both have dry headstems, can be combined before frost, and have long peduncles which make combine harvesting easy since there are fewer leaves and stalks to load down the shakers. Brighter seed color and good yields are also characteristics of these new varieties.

A new, tall Hegari has been named Hi-Hegari. Seed has been increased for distribution to farmers. It was developed by crossing a tall mutation in Early Hegari to ordinary Hegari and selecting the recombination of tall stalk with Hegari maturity. The result is a pure Hegari of tall, forage type having the same maturity and adaptation as ordinary Hegari, and yielding approximately 20 percent more forage or silage.

Pop sorghum similar to pop corn is now available with quite satisfactory expansion and popping qualities. Strain No. 5770 gives an expansion ratio of 15 to 1, is free of thick hull and gives a popped product of unusual tenderness and flavor. Although the puff or popped grain is smaller than corn, it offers opportunities in commercial confections, in addition to its value for home use.

Figure 14. Combine Kafir-60 is a new, early maturing, double dwarf Blackhul kafir variety which stands up well in the field and is adapted to combine harvesting.

Sudan grass breeding for greater resistance to foliage diseases, quicker spring growth and recovery after cutting, while preserving the palatability and high quality of Sweet Sudan grass, is progressing. Purifying seed stocks of registered Sweet

Figure 15. This panel presented the story of Texas sorghum Nov. 12, 1949 on the National Farm and Home Hour from Radio Station KGNC in Amarillo. The announcements were handled by D. A. Adam, Texas A&M Extension radio editor, left foreground, and J. B. Linn, farm director for KGNC, background standing. Left rear is R. E. Karper, in charge of Texas Station sorghum research. Right background is J. R. McNeil, certified seed grower of Spur. Right foreground is J. C. Miller, head of the Texas A&M College System Department of Animal Husbandry.

Sudan grass for sienna glume color shows up in more uniform and higher quality commercial seed supplies. This variety, developed and distributed by the Texas Station a few years ago, is now the leading variety of Sudan grass, comprising 75 percent or more of the acreage in the United States.

Soybeans

Various substations have conducted trials with many varieties and selections of soybeans to try to find some suitable for Texas growing conditions.

The Chillicothe, College Station, Denton and Ysleta stations have cooperated with the Southern Regional Soybean Lab-

oratory at Stoneville, Mississippi, in conducting uniform nursery tests. None of the varieties tested has produced satisfactory yields consistently under dry-land farming, although in favorable years yields up to 30 bushels per acre have been obtained. Ordinarily, the seed produced are shriveled and of poor quality. Under irrigation at Lubbock, average yields of about 20 bushels per acre have been obtained and the seed has been of fair to good quality.

Wheat

Wheat improvement work in Texas has resulted in the development and distribution of new varieties which are now widely grown and are contributing to more dependable crops of better quality wheat attractive to the commercial buyer. Research, largely with hard red winter wheat, is centered at College Station, Denton and Amarillo, with yield tests or disease nurseries at the Chillicothe, Iowa Park, Spur, Temple, Stephenville, Beeville, Winter Haven, Weslaco and Greenville stations, and with outlying tests at Dumas, Hereford and Comfort.

There has been a rapid expansion in acreage of the newer, high quality wheats. Westar, distributed in 1944, was grown

Figure 16. Comanche and Quanah wheat growing side by side at the Denton station in 1948. Quanah is a new variety released for seed increase in the 1950 season. The new variety is similar to Comanche in most agronomic characteristics but also is resistant to stem rust and is better for winter pasture.

in 1949 on about 2 million acres, or 26 percent of the wheat acreage in Texas. Comanche, Wichita and Austin also occupy sizable acreages. Owing to the mild winters and humid spring weather conditions, plant diseases are major factors in wheat production in Texas. The stem rust resistance of Austin and moderate leaf rust resistance of Westar, Comanche and Austin, have helped reduce the losses from these diseases. However, additional varieties with even higher resistance to disease are needed.

Quanah is the name given a new variety of hard red winter wheat to be distributed to farmers in 1950. This new variety was developed from a complex cross of (Mediterranean-Hope x Comanche) x (Comanche x Honor-Forward). Its superior characteristics include resistance to stem rust, moderate resistance to leaf rust, resistance to high bunt, and excellent milling and baking characteristics, Figure 16. It appears to approach its Comanche parent in adaptation to commercial baking purposes.

Based on extensive yield tests, Quanah will be recommended for the Rolling Plains and North-central Texas to replace the rust-susceptible varieties now grown. It is less winter hardy than Comanche and should not be grown outside the recommended area. On the basis of some observations, it appears that Quanah may not be as drouth resistant as some other varieties, but has made unusually high yields under irrigation.

Intensive breeding work is under way to transfer disease resistance and certain other characteristics from wheat and grass species somewhat related to our common bread wheats. Crossing of common bread wheat with these related species often results in sterile hybrids. But by treatment with certain drugs to double the chromosomes and restore fertility, they may be recrossed or fertile selections made. These species offer the possibility of selecting new strains highly resistant to the diseases which attack our common wheats. Many such crosses have been made and the hybrid populations are being tested for disease resistance, fertility and adaptation for special purposes.

FORAGE CROPS

Grasses

Grass trials have been conducted at College Station and on several of the substations.

Warm-season grass tests. Yield and chemical composition data have been obtained for 5 years on 10 warm-season grasses on Lufkin soil at College Station. Australian beardgrass was the highest-yielding species, producing an average of 2.42 tons of air-dry forage per acre. Rhodesgrass, Yellow beardgrass (K. R. Bluestem), Dallisgrass, Angletongrass and Weeping

lovegrass produced over 1.87 tons per year. Blue panicgrass, Caucasian beardgrass and South African bluestem did not survive severe clipping treatments. Both Blue panic and South African bluestem showed high yielding ability, producing 4.11 and 3.07 tons, respectively, the first season.

An increased yield was obtained from nitrogen and phosphorus fertilizer in most of the species the first and second seasons following application. Phosphate alone caused some increase in yield the first season. Increases in the phosphoric acid content of the grasses, due to applying phosphate to the soil, ranged from 26 to over 150 percent.

Yellow beardgrass, Johnsongrass and Dallisgrass were the highest-yielding species, with Coastal Bermuda fourth, in a 3-year test with eight warm-season grasses on the Brazos River Valley Laboratory near College Station. Nitrogen fertilizer increased forage yield from 1 to 5 times. Nitrogen fertilizer also increased the average percentage of protein in 6 of the 8 species tested in 1946, 5 in 1947 and none in 1948. However, when moisture conditions were favorable for plant growth at the time of application, the protein content of all species was increased at the subsequent cutting. Phosphorus fertilizer had no effect on the phosphorus content of the forage. Nor did treatment influence the lime content of any species.

Experiments in the Lower Rio Grande Valley indicate that South African bluestem, Yellow beardgrass, Angletongrass, Blue panicgrass and Rhodesgrass offer promise. South African bluestem and Yellow beardgrass are especially desirable because they are resistant to drouth and to Rhodesgrass scale, and produce good yields of palatable forage with a relatively high protein content. Angletongrass is also excellent for the Valley area; it is resistant to the Rhodesgrass scale, but it must be started from cuttings or clumps.

Little bluestem has done well for hay on upland meadows at Tyler where the main factors limiting yields are available moisture and fertility. Fertility can be increased by the use of phosphated early-maturing winter legumes such as low hop clover or narrowleaf vetch, or by the use of commercial fertelizer. Average hay yield over several years has been 2.25 tons per acre. Sixty pounds of seed per acre were harvested in 1949.

Yellow beardgrass is the only grass among 33 species tried at Beeville that has shown adaptation for recovering cutover brush pastures. It apparently has the ability to take hold with little or no land preparation and spread rapidly to surrounding areas. It competes well with blackbrush sprouts coming back on cutover land. Figure 17 shows Yellow beard on the Beeville station in August 1947, 16 months after seeding. The grass

was planted in 36-inch rows on an old field of badly eroded fine sandy loam soil.

Figure 17. Yellow beardgrass planted in 36-inch rows in April 1946 on badly eroded sandy loam soil near Beeville. Photographed in August 1947.

Cool-season grass tests. Kentucky 31 fescue is the most promising from the standpoint of yield and summer survival in the first year (1949) of a clipping test on 10 cool-season grass species and varieties on the Brazos River Valley Laboratory. Achenback and Lincoln bromegrasses had relatively low yields in the spring of 1949, but had excellent summer survival. The same test was planted at Denton, Iowa Park and Lufkin. Kentucky 31 fescue was the highest-yielding variety at Denton, but Alta 144 fescue had the highest percentage survival at the end of the summer. Alta fescue was the highest yielding at Lufkin; the fescues were the only species surviving the summer at that location. Alta 144 fescue was the highest yielding at Iowa Park, with Kentucky 31 fescue producing only slightly less forage. The fescues and Smooth bromegrass showed excellent summer survival under irrigation at Iowa Park.

A leaf-spot disease of Tall fescue, caused by *Cercospora festucae,* was reported at College Station and Temple. It caused serious reduction in the stand of Alta and Alta 144 fescue and some reduction in stand of Kentucky 31 fescue. The disease was also observed on Smooth brome but caused no apparent stand reduction.

Grass breeding. Progenies from individual plants of Yellow beardgrass were studied in an effort to determine the method of reproduction. Indications have been obtained that the species is apomictic.

Progenies from individual plants of Alta fescue selected for heat, drouth and disease resistance were studied and the superior plants selected for further observation, and increase and possible use in crosses or composites.

Introductions. Over 100 species and strains of grasses introduced from foreign countries are under observation for possible adaptation for forage production in Texas. Some of these species show definite promise and are being put in yield trials at various locations.

Legumes

A 3-year alfalfa variety-fertilizer test has been conducted on Miller soil, a soil of high fertility, at the Brazos River Valley Laboratory. A uniform application of 200 pounds per acre of 20 percent superphosphate was made just prior to seeding. Half of the plots received an annual topdressing of 400 pounds of 20 percent superphosphate after the first clipping in the spring.

Varieties used included Texas common, Pilca Butta, Kansas common, Chilean, Ranger and Buffalo. There was no significant difference among varieties. All except Ranger responded to the additional application of phosphate, but only Buffalo gave statistically significant increase. The average yield of Buffalo in pounds of air-dry forage per acre increased from 8,135 on the unfertilized plots to 10,098 on the fertilized plots. Texas common and Kansas common were generally the highest producers, and Chilean and Pilca Butta the lowest.

An application in 1944 of 400 pounds per acre of 20 percent superphosphate at the Iowa Park station increased the yield of alfalfa in 1946 by 1.9 tons per acre over alfalfa not receiving the fertilizer. This rate gave more economical gains than either 200 or 800 pounds of superphosphate per acre.

Miscellaneous Medicagos. A miscellaneous *Medicago* test has been a part of the research program at the Brazos River Valley Laboratory. This test included such species as Button clover, Little burclover, California burclover, Manganese clover, Cogwheel clover and strains of Black Medic. Cogwheel clover, Figure 18, is the most promising. It gave the highest forage yield and has good potentialities as a seed producer. The pods do not have spines and harvesting is easier and cheaper as the pods remain on the plant. Yields of seed and pods of Cogwheel have approached 3,000 pounds per acre.

Hairy vetch. Madrid sweetclover was seeded in a fall planting of Hairy vetch in the spring of 1947 at the Denton station. The young sweetclover held the vetch vines off the ground so that a normal seed crop of vetch was combined with a pick-up attachment without injuring the sweetclover. A seed yield of 350 pounds per acre was harvested in the spring of 1948 from

the Madrid sweetclover. With this combination of legumes, a "cash" crop was harvested each year in addition to the other benefits from grazing and soil building.

Figure 18. Individual plant of Cogwheel clover (*Medicago tuberculata*).

Texas is among the leading states in the production of vetch seed. Studies are underway at the Stephenville station to determine the most satisfactory seeding rates alone and with a companion crop, fertilizers, row spacing and the role of inoculation in seed production.

Vetch Seed Testing Laboratory. The production of Hairy vetch seed has become an important industry in parts of Texas, especially in the West Cross Timbers and adjoining areas. Vetch growers in 1947 asked the Texas Legislature to provide funds for experimental work on the production of vetch seed and for a seed laboratory to make germination and purity tests. These funds were appropriated and the Vetch Seed Testing Laboratory was organized early in 1948.

Considerable vetch seed was produced in the State in 1948, despite unusually dry weather in the fall of 1947. The laboratory received 364 samples of vetch seed for germination and purity tests that year. These tests showed that good quality vetch seed is produced in Texas.

The laboratory received 1,400 samples of vetch seed in 1949. The tests again showed that good to excellent quality seed is produced. Samples of seed were received from 77 of the 254

Texas counties. The five leading counties were: Kaufman, 121 samples; Montague, 104; Comanche, 79; Eastland, 77; and Navarro, 74 samples. Most of the samples came from the counties in the West Cross Timbers and the northern part of the Blackland and Grand Prairies, comprising the north-central part of the State.

Sweetclover. The use of sweetclover has increased considably in recent years. It is grown primarily for pasture and soil improvement, although biennial varieties, in the first year of growth, may furnish hay of a composition and feeding value approaching that of alfalfa. Its wide adaptation to soils and climate, and availability of seed have been important factors in its rapid acreage expansion. Sweetclover is unexcelled for restoring the productivity and physical structure of soils, because, through decay of its extensive root system and fixation of atmospheric nitrogen in the soil, plant foods are made available, moisture penetration is increased and workability of heavy soils is greatly improved.

Hubam, Madrid and Evergreen are outstanding sweetclover varieties for Texas growing conditions. Hubam is a white-blossomed annual, Madrid is a yellow-blossomed biennial and Evergreen is white-blossomed biennial. Hubam has aided in restoring the productivity of the Blackland soils; however, it appears that

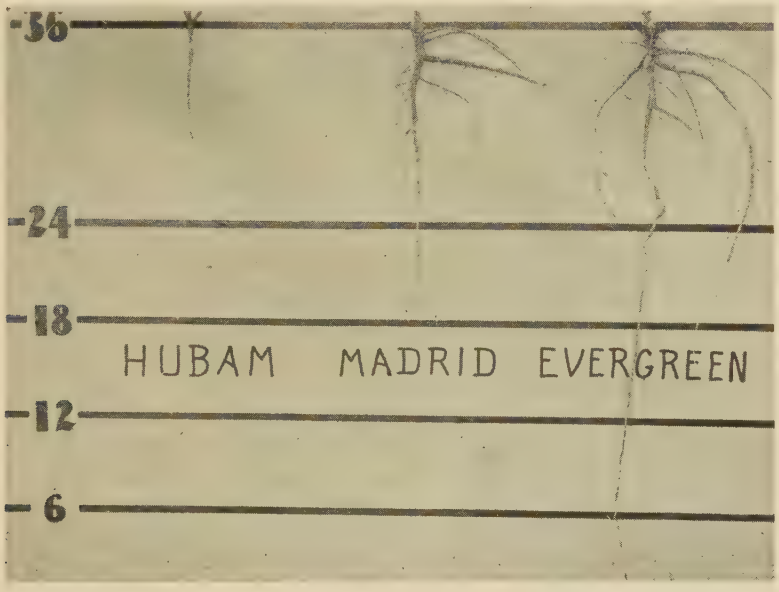

Figure 19. Root systems of hubam (annual) and Madrid and Evergreen (biennial) sweetclovers. The Texas Station is investigating the long, penetrating taproot of Evergreen as a means of loosening up and placing organic matter in the subsoil of the Blacklands.

the biennial varieties will be more effective in soil improvement and soil and water conservation, and at the same time produce an abundance of forage for livestock. A comparison of the root systems of the three varieties is shown in Figure 19.

Where the soil has an infestation of cotton root rot, fall plantings of biennial sweetclovers have been more successful than spring plantings. When the legumes are spring planted on root-rot land, a very high percentage of the plants die during July, August and September. Spring planting is recommended at Denton because fall-planted sweetclover is often winter-killed.

Madrid sweetclover has been utilized at Iowa Park for late fall and early spring pasturage. Cotton following Hubam had 30 percent less root rot and produced as much as 210 pounds more lint per acre than cotton following cotton.

Studies of the root development of deep-rooted legumes, sweetclover and alfalfa are being conducted at Denton, Temple and College Station.

Reseeding Crimson clover. Reseeding crimson clover has been recommended as a forage crop for the Gulf Coast area and East Texas. The Kirbyville station has placed emphasis on the forage and seed-producing possibilities of the Dixie variety. This variety has furnished an abundance of high quality forage for early spring grazing. A good crop of seed is normally produced, but wet weather and soft ground have made harvesting difficult. The clover should be grown with a sod-forming grass to support livestock for grazing or to support the weight of a combine for harvesting the seed. Variety tests of crimson clover are being conducted at Temple and College Station. The varieties included are Dixie, Auburn, Autauga, Common and Talladega.

Pastures

Research on pasture production has been conducted for several years at many of the substations and field laboratories.

Supplementary pastures. A 3-year grazing experiment at Beeville showed that temporary pastures pay good dividends. Yearling steers grazing rust-resistant oats for an average of 128 days made a gain of 212 pounds per steer, or 139 pounds per acre. The same steers grazing Sudan during the spring and summer gained 154 pounds, or 100 pounds per acre. Oats and Sudan furnished an average of 228 days of grazing and the average gain per steer was 366 pounds. The steers were in good condition when removed from Sudangrass at the end of the grazing period in August.

Excellent results were obtained at the Temple station by using a combination of crops for grazing at different seasons of the year. These crops have been fitted into a farming system which allows a minimum of erosion and soil depletion. Oats

and barley in combination with Madrid or Evergreen sweetclover furnished grazing from November to July. Sweetclover furnished grazing again in August and September. Sweet Sudangrass planted in April furnished abundant grazing from June 1 to August 1. Figure 20 shows steers grazing the Sudan in July. Sweet Sudan produced an average of 468 pounds of gain per acre in 1949.

Figure 20. Steers grazing Sweet Sudan in July at Temple. A combination of crops is being tested at Temple in an effort to develop a year-around grazing program.

By using grain and making hay from forages during their most productive period, the Temple station has led the way in Central Texas in maintaining soil productivity, increasing crop yields and producing quality beef.

Permanent pastures. The pasture program at Beaumont is directed toward developing better pastures and improving soil fertility between rice crops for the rice-pasture system of farming. Improved pastures on Beaumont clay soil were fertilized in 1947 with 500 pounds per acre of 6-20-0 plus one ton of lime, then seeded to Dallisgrass, Bermudagrass, Louisiana white and Persian clover. Over 200 pounds of beef gain per acre were produced on improved pastures, as compared with 50 pounds on unimproved pastures. Good stands of clovers were obtained in 1947-49 from seedings made between October 15 and early December. Clover stands from seedings earlier than October were seriously depleted from damping-off in 1948 and 1949.

The amount of oven-dry forage from several legumes indicates the possibility of producing high quality forage in rice stubble. Yields of 2.6 tons from Louisiana red clover, 2.4 from

Figure 21. Better adapted livestock and well-fertilized pastures offer an alternative for reduced cotton acreages. Shown are a White clover-Dallisgrass pasture and a crossbred Brahman-Hereford cow on the East Texas Pasture Investigations Laboratory at Lufkin.

Tallarook subterranean, 2.2 tons from Lappaceae and 2.1 tons from Louisiana white clover were obtained. Camellia oats responded well to nitrogen fertilizer in 1948. Applications of 17, 32, 46 and 60 pounds of elemental nitrogen per acre to oats gave respective increases in protein contents of from 11.78 to 17.22 percent. The forage yields per acre were 847 pounds from areas receiving 17 pounds of nitrogen and 1,635 pounds from areas receiving 60 pounds of nitrogen.

At Spur, over a period of 146 days, an average of one steer to 5.04 acres used 50 percent of the grass and gained 148 pounds; whereas, one steer to 3.4 acres used 75 percent of the forage and produced 93 pounds of gain. Pastures stocked to utilize 50 percent of the forage had 30 percent more grass cover the following year than those where 75 percent was utilized.

Highest gains at Spur for the summer grazing season were made during April, May and June. Sixty percent of the gain for the season was made by July 1, 72 percent by August 1 and 84 percent by September 1. Clipping and chemical analysis studies of Buffalo and Blue grama showed that these grasses

have a high nutritive value during the spring and summer but, without moisture, are low in protein, phosphorus and palatability in the fall. Clippings made at intervals of 8 weeks increased the yield 62 percent, as compared with the same grasses clipped at 2-week intervals. The grass cover on pastures stocked to utilize 75 percent of the forage closely resembled those on plots clipped every 2 weeks.

Experiments in the Gulf Coast Prairie showed that high quality pastures can be made when sod land is plowed in lands 40 feet wide to allow surface drainage, fertilized with 500 pounds per acre of 20 percent superphosphate, smoothed and firmed, then seeded in November to 4 pounds to Louisiana white clover, 10 pounds of Dallis and 2 pounds of Bermudagrass per acre. Excellent stands of clover were obtained the first season and good stands of Dallis and Bermuda the second and third years. It was found, in one year, that open heifers, averaging 460 pounds, gained 125 pounds on the unimproved pasture, as compared with 318 pounds on the seeded and fertilized pasture. Calves from cows on the improved pasture weighed 100 pounds more at weaning time than those from cows on the unimproved pasture.

Steers grazing burclover and Johnsongrass in the Brazos Valley have made an average acre-gain of 266 pounds per year.

Farmers have always had difficulty in obtaining satisfactory stands of Dallisgrass. Figure 22, taken in December 1947,

Figure 22. Dallisgrass in December 1947 from an April planting on the Brazos River Valley Laboratory. This was one of the higher yielding species in a 3-year test with 8 warm-season grasses.

shows Dallisgrass in 40-inch rows that was planted in April. Factors contributing to the good stand of this grass were a favorable season, a firm, well-prepared seedbed, good seed (with a germination of 35 percent) and proper depth of seeding. The Dallisgrass was planted with a regular cotton planter on low flat-top beds at the rate of 8 pounds per acre. The beds were clean and firm. The planter sweep was removed, and the opening shovel was set to just scratch the surface of the ground, making a small furrow one-fourth to one-half inch deep. This furrow was closed with the packer wheel. Weeds were controlled during the summer by mowing.

SOIL AND WATER CONSERVATION

Both vegetative methods and mechanical practices are necessary in any sound conservation system of farming. Proper management of grasses and legumes has been effective in controlling erosion and improving production. It also is proving popular with farmers because of the good economic return.

Vegetative Erosion Control

Work at the Temple station showed that grasses and legumes in the cropping system have reduced soil and water losses as much as 50 percent.

Studies at the Amarillo station showed that a wheat-sorghum-fallow-grass rotation is the most dependable cropping system in furnishing protection against wind erosion and in maintaining crop production in the Panhandle.

Work also is being carried on to determine the best forage producing varieties of different crops for erosion control. Work at the Amarillo station showed Westar, Wichita and Tenmarq are good forage-producing wheat varieties. Tests are being continued with native grass species to determine their effectiveness for erosion control and beef production. Crested wheatgrass produced more beef but is not as good as western wheatgrass in controlling erosion. Indications are that Texas Bluegrass also may be adapted to the heavier soils of this area. Efforts are being made to increase beef production by the use of better forage-producing seasonal grasses. Blue grama and buffalograss are the main varieties now in use. Sideoats grama also appears to have definite possibilities.

The Temple station is studying utilization of grasses and legumes by grazing with livestock to encourage conservation farming. Various combinations of small grain, sweetclover, tall fescue, Turkestan Bluestem, Bermudagrass, Johnsongrass and Sudangrass can be fitted into a number of systems which approach year-round green forage for livestock.

Mechanical Erosion Control

Long-time studies at the Spur station showed the advantage

in cotton production of conserving rainfall and soil by contouring and the use of closed level terraces on gently sloping clay loam soils.

Cotton planted at Spur on land farmed on contour with closed level terraces for 23 years produced an average of 56 percent more lint per acre than cotton planted on land with rows running with the slope. Contouring alone increased the yield of lint 24 percent over straight row farming. The increased yields at present market prices would give an annual increase of $14.60 per acre. The annual runoff from 1927 to 1946 was 2.75 inches for rows with the slope, 1.95 for areas with contoured rows and none for closed level terraced areas. Soil loss measurements were not made on these areas.

Supplementing the rainfall with runoff water during dry years was the most effective method at Spur of reducing the hazards of crop and livestock production in the Rolling Plains. Grazing experiments during the summer on native grassland consisting chiefly of Buffalo and Tobosa grasses show that light to moderate stocking over an 8-year period increased steer gains an average of 52 pounds per head, flesh condition two full grades, and did not reduce the acre-gain when compared with heavy utilization of the forage. The light to moderately-grazed pastures also had one-third more grass cover at the end of the fifth season than heavy-grazed pastures. Determinations of soil moisture penetration following torrential rains showed repeatedly that lighter stocking increases the amount of moisture stored in the soil by reducing runoff and erosion.

It was shown at the Amarillo station that the use of subtillage machines in producing winter wheat increased the production over that of the use of a oneway by 1.9 and 2.8 bushels per acre per crop on continuous wheat and wheat on fallow, respectively, Figure 23.

Correlation of Research and Land Conditions

The extensive formation of soil conservation districts and the work of the Soil Conservation Service with them introduced the term "Land Capability Classes." Land capability classes are marked on the Bluebonnet Farm to more closely tie the work done there with the farmer's own fields. These signs are placed along the main roads of the farm. They show the soils types and the land capability class, and give information concerning the best use of the land and its ability to produce. The limitations or hazards of use also are shown and conservation measures needed are listed, Figure 24. It is planned to correlate as much as possible of the research work on the farm with each set of land conditions (or land capability units) and soil types that have different hazards or limitations in use.

Studies at the Temple station showed wide variations in crop production and erosion control measures needed on different

Figure 23. Subtillage gave increased wheat production and protection against wind erosion at the Amarillo station.

Figure 24. Recognizing differences in land conditions for coordinated conservation at Bluebonnet Farm.

kinds of land. The farmer must recognize differences in soil, slope and erosion conditions on his farm if he is to have a well-rounded conservation program. He must use each acre according to its capability and treat each acre according to its needs.

Value Received from Conservation Practices

Much of the value received from grasses and legumes as soil-improving crops is due to the size of the root system of the crop. Work at the Temple station showed that the root system of the biennial sweetclovers are more extensive than the annuals such as hubam, Figure 19. The biennial sweetclovers show promise of becoming highly important in our conservation cropping systems.

Studies were initiated in 1948 at the Amarillo station to determine the value of different conservation practices and uses on the land. These studies will help answer such questions as:

> What must we do to keep our soil in a good physical condition so that it will remain open to the infiltration of water and utilize rainfall to a maximum?
>
> What have been the effects of past use and what are the future needs of different soils from a chemical standpoint?
>
> What are some of the basic characteristics of our soils such as wilting-point, mechanical analysis, soil reaction and others?

Mechanical measures of conservation, such as terracing and stubble mulch, are being studied at several stations.

Conservation Irrigation

Considerable expansion was made in 1948 in conservation irrigation studies. Studies started at the Weslaco station include efficiency of water application for level and graded runs, depth, spacing and size of drain tile, and permeability studies of the different soils in the area.

The Amarillo station, in cooperation with the Lubbock station and the Soil Conservation Service, set up projects on methods of water application to measure irrigation efficiencies under present methods of water application, and to develop methods of application best suited to the limited water supply, soil characteristics and cropping system of the respective areas.

SOIL AND CROP MANAGEMENT

Soil and crop management investigations include the utilization of legumes for soil improvement, methods of managing legumes, soil-building rotations and adaptation of legumes in long-time rotations.

Utilization of Legumes for Soil Improvement

The main objective of this work is to develop more practical systems of managing legumes for soil improvement. The work includes different legumes in different cropping systems, methods of planting, placement of seed and fertilizer, and disposal of vegetative growth of the legumes to facilitate the preparation of a seedbed for the following crops.

Five work plans under this project are in progress. These are: legume-corn-row system test on Miller clay near College Station; alfalfa, sweetclover and winter peas in cropping systems with corn on Miller clay near College Station; legumes as soil-improving crops for corn on Lufkin soil at College Station; rapid growing winter legumes as green manure for cotton on Lufkin soils; and hubam sweetclover, Madrid sweetclover, Austrian winter peas and Dixie wonder peas in cropping systems with corn on San Saba clay at Denton. Much of the work is concerned with biennial sweetclover.

Yield records of test crops following the clover will not be available until 1950.

Legumes as Green Manure for Cotton

Hairy vetch, Willamette vetch, Austrian winter peas, Dixie wonder peas and Singletary peas were planted on Lufkin soil at College Station in the fall of 1948.

Unusually dry weather until November and severe freezes resulted in lower yields of forage than normal. The following acre yields of green matter were obtained in the spring of 1949: Austrian winter peas, 8,500 pounds; Hairy vetch, 7,200 pounds; Dixie wonder peas, 6,500 pounds; Willamette vetch, 4,800; and Singletary peas, 4,500 pounds. Hairy vetch, however, produced the highest yield of dry matter and nitrogen per acre. Yields of cotton obtained in the experiment were much higher than the normal yield for the region. Cotton following Hairy vetch plowed under produced the highest yield, 452 pounds of lint per acre. This was significantly larger than the yield of cotton following Willamette vetch or cotton fertilized with 60-80-80 or 0-80-80.

Legumes as Green Manure for Corn

The main objectives of the work with corn at College Station is to determine the relative value of winter legumes as soil-improving crops, and whether the legumes will supply enough nitrogen to the soil.

Dixie wonder peas, Hairy vetch and Willamette vetch were planted in the fall of 1948. Because of extremely dry weather in the fall and two severe freezes, the vetches made practically no growth and Dixie wonder peas only small growth. Corn fol-

lowing Dixie wonder peas in 1949 produced significantly higher yield than corn following Hairy vetch. The application of commercial nitrogen as a side-dressing to the corn, in addition to the legumes, did not increase the yield. The nitrogen plots, however, produced much larger stalks with greener leaves than the legume plots which did not receive nitrogen.

Managing Vetch for Soil Improvement

Studies on managing vetch for soil improvement included six different methods of preparing the land and seeding. Planting on beds on Lufkin soil at College Station resulted in slightly larger yields of vetch than flat planting. There were, however, no significant differences in the average yields of cotton following vetch managed in different ways during the 4 years, 1944-47.

Planting on beds or ridges is perhaps better than flat planting, especially on slowly-drained soils such as Lufkin.

Soil Building and Soil-building Rotations

This work is conducted by the Bluebonnet Farm at McGregor. The sweetclovers, especially Madrid and hubam, are being used as soil-building crops in rotations and as crops to provide seed for use on Bluebonnet and for farmers in the region. Where possible, the clovers also will be used for grazing.

Twenty legumes have been planted in Johnsongrass areas to determine their value for grazing, haying and longevity of stand. The main purpose of the work is to lengthen the grazing period, increase the nutritional value of the forage and increase the amount of grazing per acre, while improving the soil.

Chinese Red Cowpeas as Green Manure

Three crops of Chinese Red cowpeas following small grains have been turned under for green manure from a single planting at the Denton station, Figure 25.

As soon as possible after the small grain is harvested, the stubble is turned under, the soil harrowed, and the peas are sown at the rate of 40 to 60 pounds to the acre. This variety is used because it is quick-maturing and make a good yield of seed. The plants are turned under shallow when about one seed pod is matured on most plants. A oneway plow is used.

Mature seed will germinate and a new crop will volunteer. The procedure is continued until frost kills the peas.

Two crops of green manure are obtained at Denton each year from one seeding, and three crops are obtained in some years.

This practice adds badly needed organic matter and nitrogen to the soil without interfering with the normal growing season of a "cash" crop. It should not be attempted if a fall-planted crop is to follow the small grain.

Figure 25. Chinese Red cowpeas being turned under at the Denton station after a killing frost.

Cotton Following Madrid Sweetclover

The value of Madrid sweetclover for hay, grazing and seed in North-central Texas is generally recognized. There is enough financial incentive for the farmer to grow this crop without considering its soil-building possibilities.

Madrid sweetclover also is one of the best soil-building crops for this region. It was cut for hay in August at the Denton station and the stubble turned under. Cotton on this soil the following year produced 285 pounds of lint per acre. Cotton following cotton on a similar soil produced 182 pounds of lint per acre.

SOIL FERTILITY

Fertilizer consumption in Texas has nearly tripled in the past 5 years. Many sections are now using considerable quantities of fertilizer for the first time. In other sections, the rate per acre has been greatly increased. The fertilizer research program has been reorganized and greatly expanded to provide more definite information on the proper use of fertilizers.

Proper fertilization is only one of a large number of factors which affect crop production. Others of considerable importance include variations in climate, weather, species and variety of the crop grown; various chemical, physical and biological factors of the soil; past history of the area, with particular reference to various management practices, diseases, insects, and even the

preferences or prejudices of the grower. Response to fertilization in terms of increased yield and quality of produce depends on the action and interaction of all of these factors.

Proper fertilization alone depends on many factors. The specific nutrient requirements of a crop may vary widely with different species, varieties and plant densities. The productive capacities of different soils vary greatly with respect to native or induced nutrient levels; chemical interaction between native and applied compounds; management practices such as the incorporation of green-manuring crops in the crop succession; the production of animals in the farming system; soil and water conservation practices; the time, method and location of placement of the fertilizer; and the kind, amounts and proportions of different nutrient elements in the fertilizer used.

Controlled variations in even a considerable number of these factors in a single experimental design would be impossible. Current fertilizer research is, therefore, largely limited to a detailed study of the responses which can be obtained from different amounts and proportion of nitrogen, phosphorus and potassium for a few important crops grown on representative areas of important soil types. The results of this type of study will provide information to serve as an adequate basis for fertilizer recommendations to the farmers of the State, and as basic information in a study of other factors.

The experimental design used is essentially a complete or modified factorial in randomized blocks with adequate replications. Uniform amounts of nitrogen, phosphorus and potassium alone and in all possible combinations, are used. This design gives statistically sound information on the action of a single nutrient element and on the interaction among the different elements.

Both yield and quality of produce are of primary importance. In many cases, and especially with forage crops, fertilization may be profitable, even where yields are not greatly increased, because it increases the feeding quality of the produce. Consequently, chemical analyses of many of the crops are being made to obtain quantitative measurements of the effect of fertilization on quality.

Such research is being conducted on both agronomic and horticultural crops at many places throughout the State. Many of the experimental areas are owned by cooperating farmers and provide a very important addition to the work being conducted at the substations. They also serve as demonstrations in the respective areas. Practices based on experimental results are being widely adopted by growers.

The following examples show the practical value of this type of research.

Rice

Nitrogen has been the only nutrient element which has given marked increases in yields of rice grown on heavy soils, but phosphorus is also important on the lighter soils.

Adequate fertilization produced large increases in yield, and, therefore, in net profits. The yield increases for the best treatments average from four to six barrels of rice on different soil types, and net profits were increased by $22 to $39 an acre.

Applying nitrogen at the time of seeding gave slightly better results than similar treatments made later. However, the amount of nitrogen applied is more important than the time when, as long as the date is not later than about 50 days after the plants have emerged.

Both ammonium sulphate and cyanamid were applied to rice at rates of 300, 400, 500 and 600 pounds per acre. The use of 300 pounds per acre increased the yield approximately 35 percent. The yield increased in proportion to the amount of fertilizer used, with the 600-pound application giving an increase of approximately 92 percent over no fertilization.

Ammonium sulphate and cyanamid were used for top dressing rice. Each was applied at 300 pounds per acre. The yield of rice

Figure 26. Fertilizer being applied from an airplane on rice at the Beaumont station. Strips 30 feet wide and the full length of the field are treated at a time. The pilot flies between flagmen stationed at opposite ends of the field.

was 1,624 pounds per acre where no fertilizer was used. Applying the fertilizer on dry soil produced a yield of 2,735 pounds per acre, and applying it on wet soil increased the yield to 2,625 pounds. Applying the fertilizer to flooded fields produced a yield of 1,822 pounds per acre.

Uramon, ammonium sulphate, cyanamid, ammonium nitrate and nitrate of soda were used at rates to supply 60 pounds of nitrogen per acre. Uramon gave the best results with a yield of 2,987 pounds of rice per acre. Ammonium sulphate and cyanamid produced yields of 2,907 and 2,844 pounds, respectively.

A yield of 2,538 pounds per acre was obtained from the use of ammonium nitrate, and 2,162 pounds from nitrate of soda. The untreated plots produced 1,835 pounds per acre.

Outfield tests with fertilizers on rice have been conducted by the Beaumont station for a number of years. This work was expanded in 1947 to include a large number of treatments at more locations in the Texas rice country.

Two tests are located on each of five different types of soil used for growing rice in Texas. The 1947 and 1948 results have been published and 1949 results are being assembled. They are in line with those obtained in previous work. Nitrogen alone was the most profitable treatment on Beaumont clay soil with the heaviest treatment of 400 pounds of cyanamid per acre being the best. Results between the two tests on Lake Charles clay differed slightly. However, average results indicate that 400 pounds of cyanamid (or its equivalent) with 100 pounds of 20 percent superphosphate will give the most satisfactory results on this type of soil. The fertilizer treatment that produced the largest yield on the Lake Charles clay loam was 400 pounds of cyanamid per acre in combination with 100 pounds of 20 percent superphosphate and about 65 pounds of 60 percent muriate of potash. About 200 to 300 pounds of cyanamid (or its equivalent), with a similar quantity of 20 percent superphosphate, is the most desirable treatment on Katy fine sandy loam.

Small Grains

Nitrogen appears to be the most important fertilizer constituent for increasing the yield of small grains on the sandy soils of East Texas.

On Bowie fine sandy loam near Kirbyville, 60 pounds of nitrogen tripled the yield of oats, from 15.3 to 46.4 bushels per acre, after the field had provided several months of winter grazing.

At College Station, 30 to 60 pounds of nitrogen doubled the yield of oats and increased the net profits by about $26 per acre. Nitrogen tripled the yield of wheat on both upland and bottomland areas at College Station.

At Denton, yields of oats on San Saba clay were increased from 55.2 to 68.4 bushels per acre.

Small grain planted at the Temple station early in October 1945 produced 355 pounds of dry forage and 63 pounds of protein by February 20, 1946. A similar area which received 150 pounds of ammonium nitrate per acre produced 680 pounds of forage and 150 pounds of protein per acre during the same period. This additional forage was available for livestock grazing during the winter when high-protein grazing is scarce.

Figure 27. Urine spots in an oat field on Austin clay soil. This condition indicated that the available soil nitrogen is low and that the small grain would respond to a top dressing of nitrogen fertilizer.

A spring top-dressing of 25 pounds per acre of ammonium nitrate on Austin clay at Temple in early March increased oat yields from 35 to 43.2 bushels per acre. The same fertilizer treatment on Houston black clay increased oat yields from 39.3 to 50.1 bushels per acre. In another experiment on Houston black clay, where oats followed hubam sweetclover in the rotation, 0, 25, 50, 100 and 200 pounds of ammonium nitrate per acre gave 48.3, 48.4, 53.3, 47.4 and 53.3 bushels of grain per acre, respectively. It is concluded from these data that the legume in the rotation produced sufficient nitrogen for the small grain crop that followed.

Additions of phosphorus in superphosphate may cause large increases in yield of small grains on the heavy soils of the Blackland and Grand Prairies. A large part of these increases,

particularly in the northern part of the State, is probably due to the fact that superphosphate increases winter-hardiness. Winter oats growing on a Blackland soil of low fertility near Temple produced only 12.1 bushels of grain and were severely damaged by the cold weather of the 1947-48 season, while oats which had received 100 pounds of 20 percent superphosphate were not injured and produced 34.2 bushels per acre. Similar responses to superphosphate have been evident at the Denton station, where the increases in yield amounted to 10 to 15 bushels per acre, with considerable differences due to the varieties planted.

Corn

Nitrogen has been much more effective than phosphorus in increasing yields of corn, but highest yields have been obtained when both nitrogen and phosphorus were supplied. Fertilizers increased the yield of corn at Tyler from about 6 bushels for no fertilizer to over 80 bushels for heavy applications of nitrogen and phosphorus.

Cotton

The application of superphosphate and ammonium nitrate at the Ysleta station increased the yield of lint cotton per acre in one area by nearly 200 pounds, increased the return per acre by more than $30, and gave a net return of over $5 for every dollar invested in fertilizer. In another experiment, the fertilizer increased the yield of seed cotton on a sandy soil by nearly 700 pounds, but did not increase the yield on medium or heavy soils. Nitrogen was much more effective than phosphorus.

Sixty pounds of nitrogen per acre increased the yield of lint cotton by 119 pounds at College Station in 1949. This area was on a good bottom land soil of a type that is not usually fertilized. The net increase per acre amounted to about $30 with a return of about $5 for every dollar invested in fertilizer. Phosphorus and potassium did not increase the yield on this area.

Forage Crops

Fertilizer experiments with forage crops were started in many areas of the State but the work in many instances is still not sufficiently advanced to provide adequate bases for conclusions. Certain trends, however, are apparent.

Superphosphate has been of marked value in increasing the yields of legumes on Blackland Prairie soils. This has been true whether the legumes were seeded alone or in combination with small grain, Figure 28. Superphosphate greatly stimulated both root and top production and was particularly effective in increasing the activity of the symbiotic nitrogen for the legume and increasing the value of the crop for feed or green manure. Phosphate fertilization of Madrid sweetclover at Temple in bands

2 inches below the seed increased root growth from 162 pounds to 797 pounds of dry matter per acre and increased top growth from 678 pounds to 5,614 pounds per acre.

Figure 28. Effect of phosphate fertilizer (left) on Madrid sweetclover growing in oats. The oats and sweetclover were drilled together. The 200 pounds of 20 percent superphosphate per acre were applied in contact with the oat seed or 2 inches below the sweetclover seed with a fertilizer distributor on the grain drill.

Superphosphate was quite effective on grasses. The effect has been evident in both the quantity and the quality of the forage produced. The application of 200 pounds of 48 percent superphosphate to a Nueces fine sand in Brooks county increased the carrying capacity of the area by about one-half and improved the quality (increasing the percentage of phosphorus) of the forage sufficiently to produce more calves which were also heavier and in much better condition than calves raised on unfertilized grasses. Beef gains per acre on the fertilized pasture were nearly twice those on the unfertilized pasture.

Beef production on a fertilized, improved pasture at Angleton was about three times that on an unfertilized, unimproved pasture. Both the yield and quality of the forage were increased by the fertilizer, and the net returns from the treatment amounted to several times the cost of the treatment.

Nitrogen may be of greater importance than phosphorus for grasses grown on some soils. The effect of nitrogen alone, phosphorus alone, and nitrogen and phosphorus together on the

forage yield of 8 warm season introduced grasses was determined for 2 years at the Brazos River Valley Laboratory on a productive Miller clay soil. The fertilizer treatment was nitrate of soda to give 80 pounds of nitrogen per acre. It was applied each year in a split application of 40 pounds in the spring and 40 pounds in late summer. Superphosphate to give 80 pounds of available phosphoric acid per acre was applied at the beginning of the experiment. The same rates of nitrogen and phosphorus were used when these materials were applied together. The nitrogen fertilizer alone increased yields of different grasses from 50 to 200 percent. Yields of Bermudagrass were increased from 1.7 to 4.3 tons per acre; of Johnsongrass, from 5.1 to 8.2 tons per acre; and of Yellow Beardgrass, from 5.2 to 8.4 tons per acre. Phosphorus alone did not increase the yields in this experiment, but the greatest yields were obtained when both nitrogen and phosphorus were applied.

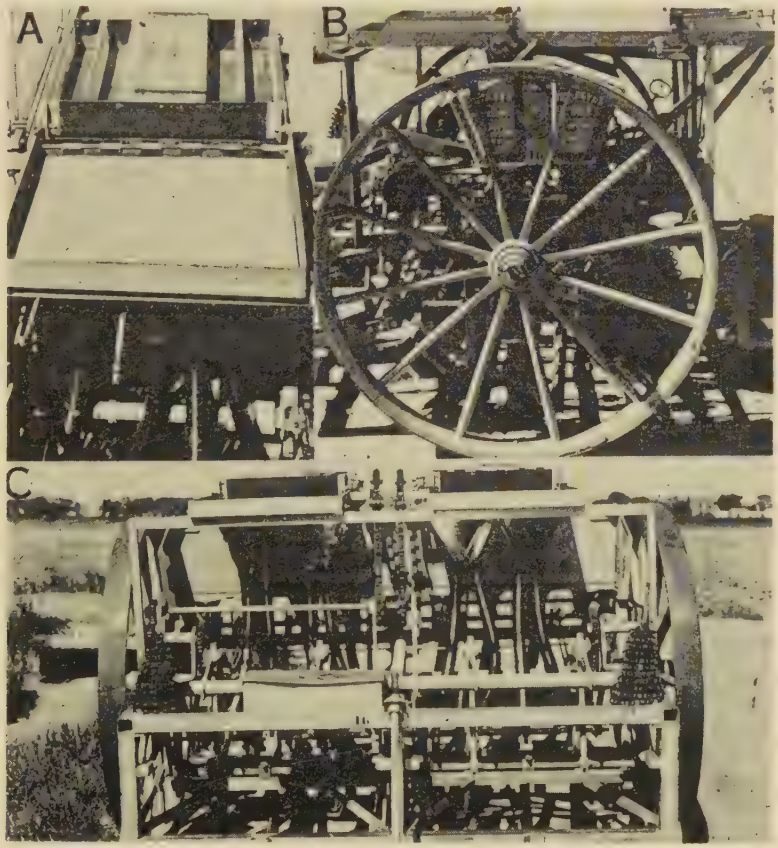

Figure 29. A—top-view of a multiple-cell, belt-type hopper for experimental application of fertilizer to small field plots. B and C—side and front-view of two of the belt-type hoppers mounted on a special grain drill.

On another area, either nitrogen or available phosphoric acid alone doubled the yield of forage, but the yields were doubled again and the quality of the forage was greatly improved when the two constituents were added together.

New Fertilizer Distributor

A six-cell, belt-type fertilizer hopper was developed to assist the experimental application of fertilizers to small plots. A top-view of one of these hoppers is shown in Figure 29A. This hopper may be used as an attachment to planting machines, tractors and other implements to greatly increase the number, kind and precision of fertilizer tests that can be conducted each season.

The new fertilizer hopper permits the application of varying ratios and rates of nitrogen, phosphorus and potash fertilizer, including the optional use of radioactive phosphorus, to small field plots without pre-mixing or weighing the fertilizer. It is self-cleaning and distributes precise and uniform amounts of fertilizer along and to a maximum of four rows. It can be mounted singly or in pairs on any tractor or implement equipped with soil fertilizer tools.

Figures 29B and C show a side and front view of a pair of these hoppers mounted on a grain drill. This drill has attachments for placing the fertilizer in numerous positions in relation to the seed being drilled.

Soil-coring Machine

Two soil coring machines, Figure 30, were purchased recently for use in various soil studies. These machines are capable of taking undisturbed cores of soil 4 inches in diameter and either 6 or 10 feet in depth. They will be used with many different types of soil studies which have heretofore been impossible because undisturbed soil cores could not be obtained. These experiments include physical and chemical studies of soil stratification and aggregation; plant root distribution; effects of different soil management, irrigation and drainage practices on different levels of the soil; and many other similar problems.

SOIL SURVEYS

A survey of the soil of Cherokee county was completed during the period covered by this report. It involved the detail mapping of about 800 square miles. Soil surveyors worked with planning technicians of the USDA Soil Conservation Service in determining the managerial requirements of the soils and in summarizing that information by soil groups in a table of recommendations. The text to accompany the soil map was written for publication by the USDA Bureau of Plant Industry, Soils and Agricultural Engineering. It uses more tabular data than previous surveys. It also emphasizes the suitabilities of the soils for various uses and how they should be managed.

Figure 30. A soil-coring machine in operation at the Weslaco station. A core of soil is being pulled up from a depth of 6 feet.

A similar report was written for the soil survey of McLennan county.

Since the initiation in 1903 of soil survey work in Texas, 210 of the 254 counties have been surveyed.

About 125 counties are covered by reconnoisance soil surveys that give information on the soils prevailing in broad localities. Some 30 counties are covered by very old surveys. About 50 counties are covered by surveys of moderate intensity that give reliable information on the kind of soil down to around 5 acres in size, but only partial information on the lay-of-the-land and erosion.

The surveys are very intensive in the five counties recently worked. They fill all needs for soil maps used in the planning of individual farms in conservation programs, recommendations of soil management for particular fields and land valuation for tax assessment or other purposes.

Detailed soil surveys were recently made of the 17,453-acre Bluebonnet Farm, the Sonora station and the Angelina National Forest. Examinations were made of the soils on about 20 proposed sites for substations, and recommendations were made of their suitabilities for field experiments.

The soil survey group worked with representatives of the Beaumont station and of the fertilizer group in 1947 and 1948 in initiating and conducting outfield rice fertilizer experiments. This was the first field experiment by the Texas station in which the soil type was treated as a variable, with replications for soil that affords a measure of the interactions between the kind of soil and the fertilizer treatment.

Descriptions of the approximately 225 soil series recognized in Texas were brought up to date.

About one-third of the work of arranging the soils of Texas in a taxonomic key and system of natural classification was completed.

WEED CONTROL

A state-wide plan for weed control investigations has been prepared and studies are under way at the Beaumont, Ysleta, Temple and Amarillo stations. Studies are soon to be undertaken at Bluebonnet Farm at McGregor, and intermittent trials are being made at the Iowa Park station.

The work at Beaumont is on the control of weeds in rice fields. Results obtained over several seasons show that the application of one-half pound of 2,4-D acid equivalent of amine salts per acre as a spray on 5 to 8-weeks-old rice, or 1 pound per acre on older rice controls actively-growing weeds with a minimum of injury to adjacent susceptible crops. 2,4-D dusts

and 2,4-D ester sprays cause severe damage to adjacent susceptible crops too frequently for their use to be advisable. Preemergence treatment of rice with 2,4-D and 2,4,5-T at both 2 and 3 pounds acid aquivalent per acre caused severe reduction and injury to rice stands.

Spray drift studies showed that airplanes used to apply 2,4-D sprays must have leakproof hoppers, booms and pumps to avoid the accidental discharge of the spray materials and unintentional damage to neighboring crops while ferrying to and from the rice fields and in maneuvering over susceptible crops. Airplane spraying of 2,4-D at elevations greater than 10 feet and when the wind velocity exceeds 5 miles per hour is almost certain to result in hazardous drift of the spray materials.

Weed control experiments have been underway for several years at the Ysleta station. This work is mostly with the use of fortified oil emulsions and soil sterilants, including trichloroacetates (TCA), for the economical control of Johnsongrass and the other weeds along irrigation canals. The following mixture has given satisfactory results over a wide range of conditions: 70 gallons of water, 30 gallons of burner oil, 2 quarts of 20 percent pentachlorophenol solution and 1 pint Triton X-100 (wetting agent). The cost of this emulsion should be about 4 to 6 cents per gallon. About 160 gallons are required per acre in vegetation of average density. Published results of the Ysleta work show several substitutions can be made in these ingredients.

Figure 31. The effect of sodium TCA (trichloroacetate) on Johnson grass 4.5 months after application.

The work begun at the Temple station in 1949 is also on the control of Johnsongrass, especially around buildings, along field boundaries and limited infestations in cultivated fields. This work has not been underway long enough to make any recommendations, but promising results were obtained with both sodium and ammonium trichloroacetate, Figure 31. The cost of the materials limits spraying operations to small areas. Fortified oils, dinitro and soil sterilants are also being tried on Johnsongrass at Temple, and 2,4-D and control sprays are being tested as a means of disposing of winter vegetation.

An extensive research project on the control of field bindweeds and other broadleaf perennials was started at Amarillo in 1949. This work has the attention of a full-time staff member. It involves the use of intensive tillage methods, supplemented by the use of chemicals to control bindweeds on cropland and the use of soil sterilants to control this weed on noncropland. Considerable expansion of the work at Amarillo in the near future is anticipated.

Trials at the Iowa Park station showed that two burnings with a kerosene weed burner from 1 to 3 days apart and at intervals of 3 to 4 weeks will keep the channels of irrigation ditches open where they have become infested with Bermudagrass.

Figure 32. A group of yearling steers at the Beeville station grazed 132 days on Rustler oats, then 79 days on Sweet Sudan. No concentrates were fed.

Animal Husbandry

BEEF CATTLE

The New Animal Husbandry Center

The consolidation and relocation of the animal husbandry land, livestock and barns west of the railroad tracks at College Station involve beef cattle, horses, swine and sheep. The land lies in one block comprising about 1,200 acres, and includes most of the land now occupied by the Department of Dairy Husbandry plus land which has been in use by the Department of Animal Husbandry. Approximately half of the land is improved, the remainder being rough and brushy unimproved land.

Plans call for modern barns complete with facilities for teaching and research. The beef cattle center is nearing completion. It consists of an all-steel and cement block structure with about 30 stalls, a small judging arena, two student rooms, an office and a laboratory. Adjacent to it is a quonset feed barn 40 by 120 feet. Oil field pipes and sucker rods were used for stall partitions and for fencing adjacent lots.

The present dairy feeding barn will be converted into an experimental feeding unit. Other dairy barns in good repair will

be converted into experimental units while some of the older buildings will be salvaged.

The horse unit will be located near the present steer feeding pens, south of the beef cattle center. It will consist of a steel and tile barn, with an adjoining feed barn, and a four-stall stallion barn with individual two-acre paddocks for each stallion.

The new swine unit will be located near the site of the present teaching swine unit, which is directly west of the beef cattle center. It will be of tile and steel construction, and will consist of a central unit containing feed storage, classroom, student quarters and laboratory. Two wings will project from the ends of the central unit to form a "U." One wing will be a farrowing barn, the other an experimental unit. Additional colony houses and test plots will complete the units. Pasture and nutritional investigations and progeny performance testing will make up the more important research work of the immediate future.

The sheep unit will remain at its present location with minor improvements.

Adequate, hard surface roads and new fences will complete the four livestock units, which, when finished will present an attractive appearance and be easily accessible to visitors at all times.

Studies on a Phosphorus-deficient Range

Experiments begun in 1936 showed that a phosphorus deficiency exists in the Gulf Coast area of Texas, and that beef cattle production can be increased by supplying additional phosphorus to breeding herds. It was found in four calf crops on the Encino division of the King ranch between 1941 and 1946 that phosphorus can be supplied satisfactorily by bone meal or crystalline disodium phosphate in self-feeders.

Better results were obtained, however, from the addition of a soluble phosphate in the drinking water to furnish approximately 6.5 grams of phosphorus per cow daily, and by the addition of superphosphate to the soil. Bone meal in self-feeders increased the average calf weight weaned per cow per year by 149 pounds over the control group of cows which did not receive a phosphorus supplement. Disodium phosphate added to a controlled supply of drinking water increased the average calf weight weaned per cow by 181 pounds.

The pasture fertilized with 200 pounds per acre of triple superphosphate, and stocked with approximately 50 percent more cows, gave 208 pounds more calf weight weaned per cow per year than the control group of cows. Fertilization of this 640-acre pasture in 1941 provided adequate phosphorus through the vegetation for the cows under that treatment until the severe

drouth of 1945 and 1946. This pasture also showed indications of being overgrazed during the latter part of this period. The cows not only lost considerable weight but the inorganic phosphorus content of the blood of some of them dropped to low levels.

A third phase of the experiment, involving seven 640-acre pastures, was begun in the fall of 1947. Additional objectives include finding the comparative values of the application in that light-rainfall area of 300 pounds of raw rock phosphate and 20 percent superphosphate, respectively, per acre in the prevention of "creeps," or aphosphorosis; grazing capacities under respective treatments; and vegetative changes in the principal forage grasses as may be influenced by the application of phosphates to the soils.

The 640-acre pasture originally fertilized in 1941 was retained in the new experiment to determine whether any further response to that application continued. However, determinations of inorganic phosphorus content of the blood of lactating cows and analyses of samples of brownseed paspalum (*Paspalum plicatulum*) at 28-day intervals from October 1947 to September 1949 consistently indicated that practically all response to the original application had ceased.

Lactating cows on the two pastures fertilized in 1947 with 300 pounds of raw rock phosphate per acre showed symptoms of "creeps" during the 1948 grazing season. A phosphorus supplement was, therefore, supplied until the spring of 1949, when an additional 300 pounds of raw rock phosphate per acre were applied to these two pastures. Since the 1949 rainfall was ample in that area, the cows have remained thrifty. Insufficient time has elapsed to give any definite indications of response of range grasses, if any, in these pastures to the total of 600 pounds per acre of raw rock phosphate.

Pasture fertilization may cause a change in the botanical composition of the flora as well as a change in the chemical composition of the forage. To provide information on these problems, 3 one-acre enclosures were located in each of seven 640-acre pastures. These enclosures are used to study the effect of fertilization, grazing, and height and frequency of clipping (simulated grazing) on forage production and its chemical and botanical composition. A study is being made of the fertilization, clipping and grazing treatments on the root system of the "key" grasses. Data relating to grazing capacities, both seasonal and yearlong, are being accumulated in the carrying capacity studies on a no-treatment pasture, one treated with 300 pounds per acre of 20 percent superphosphate, and one treated with 600 pounds of raw rock phosphate as a check on current practices and the accepted rate of stocking by cattlemen in the area.

Sufficient data are not yet available on calf crop percentage and weaning weights to warrant their inclusion.

White Fat and Vitamin A Deficiency

Hereford steers fattened at the Spur station on rations consisting of grain, cottonseed meal and cottonseed hulls have shown white fat. Such rations are deficient in carotene, and the body reserves of vitamin A of steers fattened on them become depleted. Hereford steers showed greater tendency to white fat than either Jersey steers or crossbred Hereford-Jersey steers. Most of the crossbreds and part of the Jerseys fattened on the depleted rations showed white fat, but a few showed yellow-colored fat. There was a positive correlation between yellow color and the carotene content of the fat.

Low carotene or depletion rations, and time required for depletion have been under study at Spur since 1934. Summer grazing conditions and the time required for depletion of vitamin A reserves seem to be correlated. The yearling steers used in 1947-48 showed nightblindness, an early symptom of vitamin A deficiency, after 84 days in drylot. Two of the steers used in 1948-49 showed nightblindness after only 6 weeks in drylot. These are the earliest depletion times recorded in 14 years at Spur.

The summers of 1947 and 1948 were very dry. Reports indicate many West Texas cattle were similarly affected with vitamin A deficiency.

Inheritance of Eyelid Pigmentation

Eyelid pigmentation has been studied in 85 matings of Hereford cattle, Figure 33. The sire, the dam and the progeny were

Figure 33. The steer at the right has red or pigmented eyelids. The eyelids of the steer at the left are non-pigmented.

classified in each case on the extent of pigmentation in the eyelid area. The right and left eyes were studied separately.

Statistical analyses of the data indicate that about one-third of the observed variation in extent of pigmentation is due to heritable differences which can be selected for with success. If breeding stock are above average in the extent of eyelid pigmentation, their progeny will also be above the breed average. Apparently, a permanent gain of about one-third can be realized each generation.

There is some belief among breeders of cattle that the incidence of "cancer eye" and other eye afflictions is higher among cattle with non-pigmented eyelids. No study has yet been completed to determine just how much difference pigmented eyelids make in the incidence of "cancer eye." Some authorities state that the evidence of relationship of pigmentation to susceptibility to "cancer eye" is sufficiently impressive to warrant breeding for red around the eyes; also, that matings show that the amount of pigment can be increased by selection of red-eyed sires and dams.

Wintering Beef Calves

Calves on wheat pasturage at the Spur station make an average daily gain of 2 pounds per head during favorable winters.

Calves wintered in drylot on sorghum bundles or silage with 1 to 2 pounds of cottonseed meal per head daily make gains of 1 to 1.5 pounds at a cost of 10 to 12 cents per pound, Figure 34. These calves made higher gains than calves wintered on

Figure 34. Yearling steers used in feeding experiments at the Spur station.

grass pastures or stalk fields, but they gained slowly when first turned out on grass in the spring.

Native grass pastures supplemented with cottonseed cake produce almost as much net gain as the drylot ration, because calves gain rapidly on spring pasturage. Calves fed 1 pound of cottonseed cake on grass pasture gained .89 pound per head daily. Another group fed 2 pounds of cake averaged 1.15 pounds per head daily gain.

Sorghum fields are used for wintering calves after the grain has been combined, but this type of grazing usually gives poor results. The calves have to get supplemental feed to keep them gaining.

Progeny Testing of Beef Cattle

A Central and East Texas beef cattle sire and progeny testing service, similar to the one underway for 7 years at the Balmorhea station, was set up at Bluebonnet Farm in McLennan and Coryell counties.

There are three general objectives of the Bluebonnet experiments: to determine comparative rates of gain of calves of individual bulls; to identify bull calves that will gain rapidly when self-fed under uniform conditions; and to determine

Figure 35. A progeny group used in the test at Balmorhea. A similar test was started in 1949 at Bluebonnet Farm, and one is planned to get underway in 1950 at PanTech Farms.

heritability values of economically important characters in beef cattle.

About 120 bull calves are being handled at Bluebonnet for a 154-day drylot feeding period which began November 1, 1949. Hereford, Shorthorn, Aberdeen-Angus and Brahman bull calves belonging to Texas residents are entered. Bull calves accepted were divided into groups of 12 or less. They are being self-fed a mixture of cottonseed meal, ground milo, chopped alfalfa hay, chopped Johnsongrass hay and ground limestone. Feeding costs will be prorated. Each calf was weighed at the beginning and will be weighed at the end of the feeding period, and each 28th day during the experiment.

A field day will be held at Bluebonnet Farm at the end of the 154-day feeding period. Results of the experiment will be analyzed and the test calves will be on display.

Research at the Balmorhea station since 1941 has added considerable to our knowledge of the inheritance of economically important characters in beef cattle. Wide differences were found in the ability of bull and heifer calves to make rapid

Figure 36. Feed lot equipment at the Balmorhea station used for winter feeding to determine rates of gains of bull calves from herd bulls used by cooperating breeders. The 12 pens have a capacity of about 255 cattle. Satisfactory development and gains are obtained from self-feeding mixed rations consisting of 12 percent cottonseed meal, 20 percent ground alfalfa hay and 68 percent ground Hegari bundles.

gains. Up to one pound difference in average daily gain was found between sire groups, and greater differences have existed among individual animals.

It was found at Balmorhea that a large part of the differences in ability to gain is controlled by heredity. By mating high-gaining bulls to high-gaining females, it is possible to produce a strain of beef cattle in which the rate of gain is well above that of unselected sires and dams.

It was also found at Balmorhea that type is highly heritable. Significant progress can be made in an individual breeding program by retaining for breeding stock the calves which show superior type, Figure 35.

Heifers were included in the 1947-48 and 1948-49 Balmorhea progeny groups. The heifers are to be bred on their home ranches to bulls which have shown superior ability to gain.

The Balmorhea experiments have proved beneficial to cattlemen of the Trans-Pecos country. Facilities at the field station have been enlarged several times, Figure 36. From one owner in 1941, the program has grown to include around 200 head per year from about 20 owners.

Low Grain Rations for Fattening Yearling Steers

Two groups of steers which graded Good to Choice, weighing 1,025 pounds on the market, were produced at the Spur station with only 252 pounds of sorghum grain and 560 pounds of cottonseed meal per head over a 140-day feeding period. Sorghum silage, alfalfa hay and cottonseed hulls were included in the ration.

One group of these steers from light-grazed summer pasture gained 2.38 pounds per head daily, and the other group from heavy-grazed pastures gained 2.28 pounds daily. Thirty-three percent of the steers on the light-grazed pastures and 7 percent of the steers on the heavy-grazed pastures had carcass grades of Low Choice.

Physiology of Reproduction

Studies were made on the time and method of implantation of the bovine embryo. Cows were bred and the time of ovulation was determined by palpation. These cows were slaughtered at intervals of 676 to 816 hours and the progressive embryonic and uterine changes were observed, both grossly and microscopically. There is no intimate union of the embryonic and maternal tissues prior to 33 days after ovulation. During this preimplantation period, the embryo receives its nourishment entirely from the uterine secretions.

Since many embryos died during their early embryonic period,

information as to the time of implantation offers a step toward answering the question of whether the establishment of an intimate physiological relationship between the embryonic and maternal tissues is the critical point in embryo development. If any antagonism exists between fetal and maternal tissues due to genetic differences, they will, most likely, be manifest at the time of implantation.

Some factors which will modify or change this process of implantation will be studied to find the probable cause of embryo deaths.

Developing Feeder Steers

Pasture experiments under conservation practices with cool and warm-season grasses at the Amarillo station gave some outstanding gains in developing feeder steers.

Forty-seven steer calves averaging 400 pounds were received at the station December 1, 1946. After wintering on wheat and native pasturage with cottonseed cake and sorghum bundles, they were pastured on cool and warm-season grasses, including Sudan, from April to October 1947. During October, they were fed ground hegari bundles and cottonseed cake while on pasturage. They averaged 998 pounds on November 1, a gain of 498 pounds in 11 months, mostly from pasturage.

Breeding Experiments at Bluebonnet Farm

A long-range beef cattle breeding experiment was set up at Bluebonnet Farm, as the Texas phase of a regional beef cattle breeding project.

The objectives are to isolate and develop within pure breeds and certain of their crosses, strains of cattle superior under Texas conditions in rate and efficiency of gain, carcass value and heat tolerance.

Hereford and Brahman cattle are being used in this experiment. About 300 cows, about 200 heifers and a number of bulls are included in the breeding herd.

This experiment may continue for as long as 25 years.

Steer Gains from Small Grain Pasturage

Hereford yearling steers winter-grazed on Rustler oats for 119 days in 1947 at the Beeville station gained 198 pounds per head. The gain in 1948 was 204 pounds per head in 132 days, and in 1949 was 236 pounds per head in 133 days. The average daily gain for the three winter-grazing seasons was 1.66 pounds.

Each year the steers were in good flesh at the close of the oat grazing season and could have been sold for slaughter. In fact, a large number of cattle have been marketed for slaughter from small grain pasturage in this South Texas area within the

past few years. The development of rust-resistant varieties of oats has stimulated the use of winter pasturage.

It is the practice at Beeville to go from oats to Sudan pasturage, then follow with a short drylot finishing period. Figure 32 shows a group of Beeville station steers about ready to go to drylot for finishing.

Fattening Steers in the El Paso Valley

Studies at the Ysleta station, Figure 37, show that steer feeding may provide a satisfactory means of marketing low-

Figure 37. Choice heavy feeder yearling steers used at the Ysleta station in a study of feeding practices.

grade alfalfa hay in the El Paso Valley, and that a combination of cottonseed hulls and alfalfa hay is a safer roughage to feed with cottonseed meal and ground sorghum grain than alfalfa hay alone. Gains were about equal, but bloat was practically eliminated when cottonseed hulls replaced part of the alfalfa hay.

The El Paso Valley has a good climate for feeding. Market gains of 300 pounds per head have been obtained on Choice heavy yearling steers in 140 days. Such gains were made on an average daily ration of 2.5 pounds of 43 percent protein cottonseed meal, 11 pounds of ground sorghum grain, 8 pounds of cottonseed hulls and 8 pounds of alfalfa hay.

SHEEP

Skin Fold in Sheep

Most fine-wool sheep breeders contend that fine-wool breeds must carry skin folds for high production. To get comparative data on this question, the Sonora station flock of registered Rambouillet ewes was divided in 1945 as nearly as possible into a smooth group and a group with folds intermediate in size and number. Smooth-bodied rams were bred each year to the smooth group of ewes, and rams with intermediate folds to ewes with intermediate folds.

When all ram lambs dropped in 1946, 1947 and 1948 were adjusted to a 6-months' age basis, the smooth-bred group showed 27 points less skin folds, .4 centimeter longer wool staple and 2 pounds per head more body weight than the folded group.

For the ewe lambs, the smooth group had 19 points less skin folds per head, .25 centimeter longer wool staple and 5 pounds per head more body weight than the folded group. As yearlings, the smooth ewes had 27 points less skin folds per head, .10 pound less grease wool, .10 pound more clean wool, .5 centimeter longer wool staple, and the same 5 pounds per head more body weight than the folded group. The smooth group of ewes also averaged 4.5 percent higher lamb crops the past 2 years.

It will be necessary to continue this test for 12 to 15 years longer with the best sires available in both groups to determine whether the higher production figures obtained to date for the smooth-bred Ramboullets can be maintained.

Progeny Testing of Sheep

This experiment is set up at the Sonora station in an effort to locate and perpetuate sires that are more prepotent in their characters for rate of staple length, fleece production and desirable body conformation, and to determine the percentage of heritability of these characters.

Registered sheep breeders bring a minimum of six ram lambs each by one or more of their top stud rams to the station where records are obtained on body development and wool growth on the same ration and under the same environmental circumstances for 10 to 11 months.

The first experiment was begun in July 1948, when 12 registered Ramboullet sheep breeders brought in 75 ram lambs sired by 12 stud rams. The Sonora station also had 14 rams in the test by 2 stud rams.

The rate of gain varied from .32 to .40 pound daily. This difference, in a 90-day feeding period, amounts to approximately 8 pounds per head more weight for the fastest-gaining group.

Clean wool production, on a 12-months basis, varied from a low of 6 pounds to a high of 7.3 pounds per head per group. With clean or scoured wool figured at $1.50 per pound, the difference in money value is $1.95 per head.

Staple length has been generally deficient in Rambouillet sheep. This experiment is of special value in locating sires that will improve this character. The average staple length for the 14 sire-groups in the 1948-49 test was 3.37 inches. The group with the greatest staple length had 3.58 inches, and the shortest staple length was 2.99 inches.

This study is to be continued for several years, and may include several different breeds of sheep. With all records being obtained on a mechanical basis, and all of the sheep developed under the same environmental conditions, it is felt that great progress can be made in sheep improvement through this experiment.

More and Heavier Lambs from Light Stocking

Experiments conducted on lamb and wool production since 1944 at the Barnhart range station show that the lamb crop produced and the average weight of the lambs have varied almost directly with the rate of stocking.

This variation has, in most cases, been evident during the same year in which the stocking was reduced. The lightest-stocked pastures produced the heaviest lambs and the highest percentage lamb crop. The production of wool during the same period has not been consistent with lamb production, there having been no apparent increase in wool production as a result of lower stocking rates.

Rate of stocking in the seven experimental pastures, 1944-47, ranged from a low of 31.23 acres to a high of 18.42 acres per animal unit. In the same order, the lamb crops averaged 128.6 and 89.2 percent, and lamb weights averaged 81.8 and 68 pounds. The contrast in lambs between a lightly-stocked pasture and a heavily-stocked pasture is shown in Figure 38.

Sorghum By-products in Lamb Feeding

Sorghum gluten meal and sorghum gluten feed are by-products in the extraction of starch and other material from sorghum grains.

Sorghum gluten meal and cottonseed meal, each having 41 percent crude protein, had about equal value in rations for fattening lambs The meals were used comparatively in two feeding trials at College Station as supplements to ground sorghum grain and alfalfa hay.

A mixture of 3 parts of 23 percent protein sorghum gluten feed and 7 parts ground sorghum grain fed with alfalfa hay also

produced satisfactory gain and finish in two feeding trials, Figure 39.

Grain sorghum gluten feed used as the only concentrate with alfalfa hay did not produce satisfactory gain and finish.

WOOL AND MOHAIR

Wool research was directed to the development and refinement of core sampling methods to determine accurately the clean yield of commercial lots of wool. This work is being continued to simplify sampling procedures and treatment of the core samples in the laboratories.

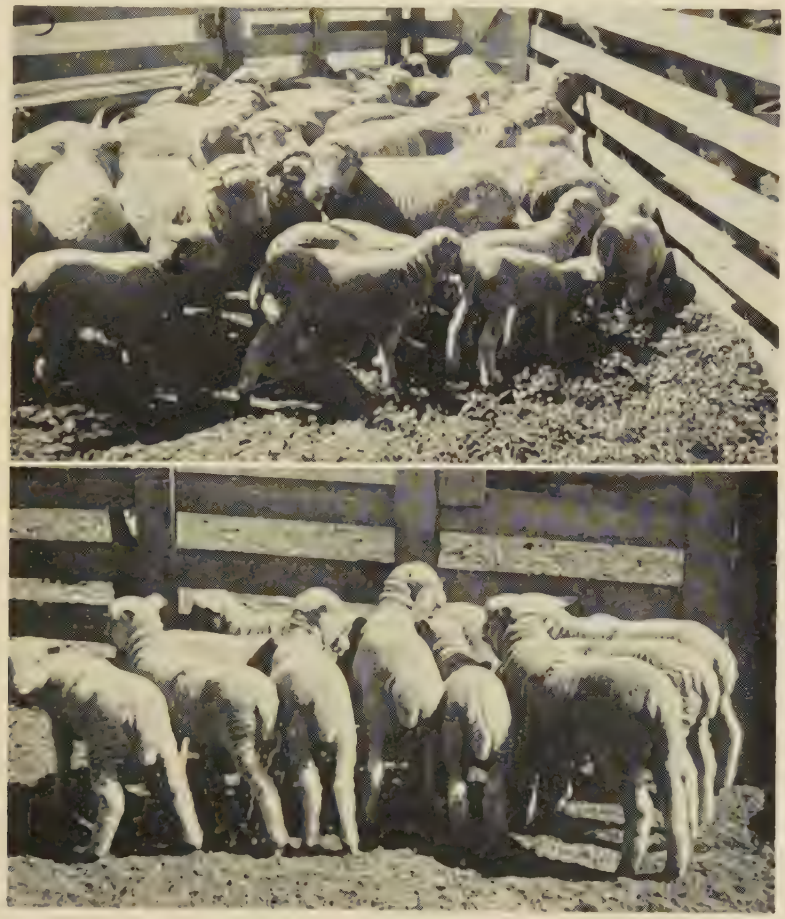

Figure 38. Top—lambs and ewes from a heavy-stocked pasture, June 1, 1948. Notice the small size of all lambs, and the "dogied" appearance of several. Bottom—lambs of similar breeding from a light-stocked pasture, June 1, 1948. Notice the size and vigor, and the absence of runts.

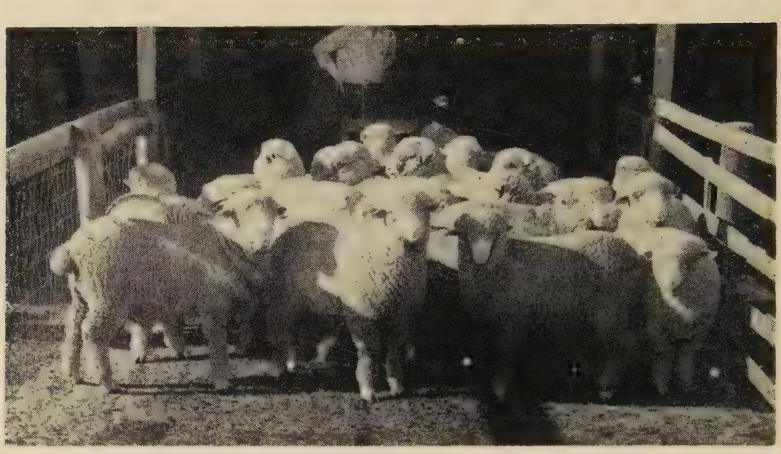

Figure 39. Notice the condition of these lambs at the end of a 93-day feeding period in 1947-48 in which they were fed a ration containing three parts sorghum gluten feed and seven parts ground sorghum grain, with alfalfa hay.

A total of 1,474 tests was made and 503,062 pounds of wool were scoured at College Station in 1947-49.

Research on the preparation and processing of Texas wools for more efficient utilization and for marketing according to quality was continued during 1949.

One million pounds of Texas wools were sorted at Fort Worth into grades acceptable to manufacturers in an effort to put these wools in condition to compete with Australian wools. This is the first time that such work has been conducted in any of the wool-producing states by qualified commercial wool graders and sorters.

Research was conducted in the Wool Scouring Plant on wool and mohair from animals in the Station sheep and Angora goat breeding studies. These activities included the commercial grading of wool and mohair by microprojector measurement of fibers, measurements of wool for staple length and scouring individual wool fleeces for clean yield. This service was also extended to a number of private breeders.

A total of 24,026 pounds of mohair were scoured, and 26,000 pounds were graded and sorted during the past 3 years.

The Wool Scouring Plant has been moved from College Station to Bluebonnet Farm, as the sheep and goat breeding programs are now centered at Bluebonnet.

SWINE

Grain Sorghum Products for Fattening Pigs

Experiments indicate that the protein supplement for fattening hogs may contain up to 30 percent sorghum gluten meal.

Gluten feed is not as good as gluten meal as a feed for fattening hogs.

Since grain sorghum by-products contain a low-quality protein, it may be better practice to replace about 20 percent of the grain with these by-products rather than use them as a part of the protein supplement when feeding the grain and protein supplement free-choice in self-feeders.

Cottonseed Meal as a Feed for Swine

Solvent-extracted cottonseed meal gave economical gain when compared with tankage and meat scraps in swine feeding experiments.

This is evidence that when the toxic substance is removed from cottonseed meal, the product is an excellent and safe protein supplement for pig rations.

Vitamin B_{12} for Swine

Experiments show that protein supplements from vegetable sources, such as soybeans, can be improved with the addition of vitamin B_{12}. Pigs fed the B_{12} vitamin made 31 percent greater gains than pigs receiving the same ration without this vita-

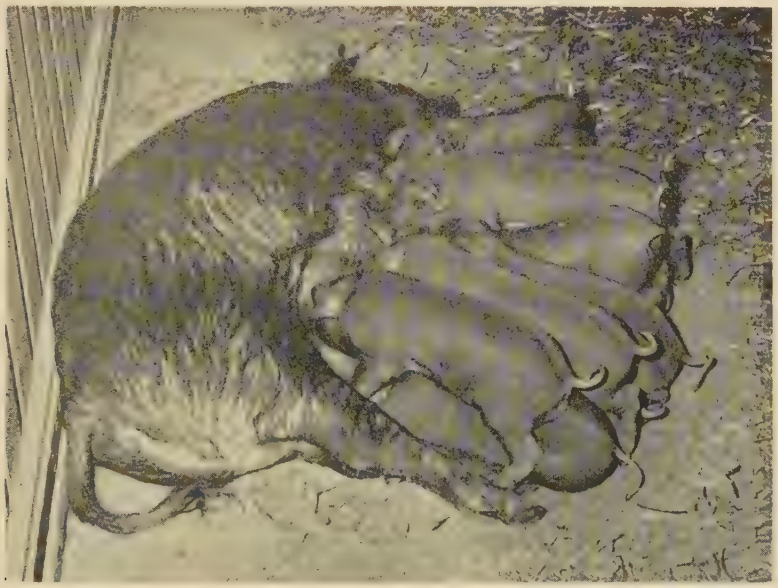

Figure 40. Good breeding, with proper feeding and management, produces strong, vigorous pigs. Notice the type, excellent bone and quality of this litter of nine uniform pigs. A brood sow must be fed a well-balanced ration and give lots of milk to produce and develop good pigs like these. Notice the good heads of the last two pigs.

Figure 41. A pig brooder, or a reflector-type flood lamp will help save pigs farrowed in cold weather. It keeps the pigs from becoming chilled the first few days after birth.

min. The pigs getting the B_{12} vitamin also required 22.7 pounds less feed per 100 pounds of gain than did the pigs on the check ration.

MEATS

Summary of Recent Research

The effects of salt, pepper and sage, alone and in combinations with each other, were determined on ground frozen pork held at 0° F.

A recommended method of producing desirable smoked turkeys was developed.

A procedure for producing turkey steaks was developed, and yields were checked on different classes and weights of turkeys.

The efficiency of four commonly-used locker wrappers in controlling weight loss on frozen meats was checked.

The effect of different wrapping materials on the freezing rate of uniformly shaped packages of hamburger meat was determined.

A desirable method was developed for smokehouse-cooking of less demanded cuts of meat to make them more desirable.

The value of a thermoplastic wax (called "no-air wrap") as a packaging material for frozen food lockers was checked.

Cut-out values for chuffy vs. good conformation hogs were recorded.

The efficiency of different waxes and refined cottonseed oil in protecting cured pork in storage was checked.

The effect of antioxidants and of vegetable oil shortening on the stability of lard was determined.

The efficiency of pasteuray lamps (ultra-violet) in reducing mold and bacterial damage to meat stored at 34-36° F. was studied.

Palatability and tenderness were determined on steers making continuous growth vs. those having interrupted growth.

An experiment was run on the effect of different scalding temperature and different frozen storage temperatures on the storage quality of fryers.

The Department of Biochemistry and Nutrition has studied the prevention of rancidity in frozen-stored bacon, using samples furnished by the Meats Laboratory. The effect of enzymes has been emphasized.

Figure 42. A representative sample of Broadbreasted Bronze turkeys, 6 months old, from a flock maintained on an unsatisfactory feeding and management program that produced varying degrees of color formation.

Biochemistry and Nutrition

Effect of Lysine on Turkey Plumage

Texas Broadbreasted Bronze turkey breeders have had trouble with poor quality of plumage and with white feathers on Bronze birds. Two diets were developed in a study of possible causes. These diets were the same except that one contained about 0.82 percent of the amino acid lysine and the other about 1.30 percent lysine.

Two comparable groups of poults were fed the low lysine diet for 4 weeks. All grew white wing feathers. Three feathers were removed from one wing of each poult to be used for later comparison. Half of the poults were continued on the low lysine diet and the others were fed the high lysine diet.

At 8 weeks, the feathers from the birds on the low lysine diet were white and those on the diet high in lysine were normal in color, Figure 42. The diets were then reversed and fed until the birds were 12 weeks old. Feathers on each bird on the low lysine diet during the 8 to 12-weeks period were white, and those from the high lysine diet were colored.

These studies showed that poor coloration of Broadbreasted

Bronze turkeys can result from feeding a ration which is deficient in lysine. It was also found that the rate of feather growth was affected by the amount of lysine in the feed. Since lysine is a constituent of protein, the proper balance between protein supplements and grain is important. Excessive grain feeding may result in plumage of poor quality.

Folic Acid Studies With Turkeys

When folic acid, one of the new B vitamins necessary for growth, feather development and hemoglobin production in poultry, was omitted from diets fed to turkeys, the birds failed to thrive, as shown in Figure 43.

Figure 43. The bird on the left received a low folic acid diet for 8 weeks while the one on the right received an adequate diet. Notice the unthrifty condition, smaller size and poor feather development of the deficient turkey.

Methods of analysis were devised to determine the folic acid levels in the blood. It was shown that both the free and combined forms of vitamin were rapidly depleted from the tissues. The levels of the vitamin were rapidly restored to normal when folic acid was administered, and a rapid rise in hemoglobin production occurred.

Other studies showed that a higher mortality and a slower rate of growth were obtained for poults from hens fed a low folic acid diet, as compared with poults from hens fed adequate diets.

These studies emphasize the importance of feeding a good breeder ration to obtain thrifty poults.

Amino Acid Composition of Texas Feedstuffs

Differences in the nutritional value of protein feeds are due largely to differences in their content of the essential amino acids.

As part of the program on the evaluation of the protein in farm feeds, the 10 essential amino acids have been determined in about 200 samples including about 100 different kinds of material. By the use of these data, the content of each of the essential amino acids in a ration containing a number of different components can be calculated with considerable accuracy, and deficiencies can be avoided.

The bacteria in the rumen of cattle and sheep have the capacity of synthesizing amino acids, or of converting one kind of amino acid into another. For this reason, the distribution of essential amino acids in rations for the ruminants is of less significance than is the case with poultry or swine.

Riboflavin Cures Leg Trouble in Turkeys

Investigations made on commercial flocks where a high incidence of leg trouble occurred show that riboflavin is the chief nutrient involved in most of the leg trouble that develops in Broadbreasted Bronze turkeys.

Twenty-three percent of the turkeys that received a diet low in riboflavin developed some form of leg disorder during an experimental period of 23 weeks, Figure 44. None of the 68 birds in the control group, which received a diet high in riboflavin, developed the trouble.

Figure 44. Left—curled-toe paralysis in a turkey from a commercial flock. Right—the same bird 5 days after two doses of 5 milligrams of pure riboflavin were administered orally on alternate days.

Leg trouble was cured recently in two commercial flocks by administering relatively large doses of riboflavin to the affected birds. The turkeys in one flock were 16 weeks old and approximately 50 percent were affected. The symptoms had been present for less than 2 weeks but were severe in a few of the birds when the treatment was begun. Twelve of the most severely affected birds were given two doses of 5 milligrams each. There was a marked improvement within 48 hours and all recovered within a week. The recovery was so spectacular as to leave no doubt as to the effectiveness of the riboflavin treatment. An analysis of the diet for riboflavin showed that it contained approximately 2.5 milligrams per pound, which is more than is considered necessary.

The experience with the second flock was very similar. However, the incidence of leg trouble was lower but the symptoms were very severe, and it took longer for the birds to respond to the treatment. Twenty-five of the severly affected birds in this flock were given 5 milligrams of riboflavin each on alternate days for 2 weeks. Thirteen recovered completely. The 12 which did not recover may have been in such bad condition that recovery was impossible.

It is obvious that either the requirement of Broadbreasted Bronze turkeys for riboflavin is much higher during certain periods of growth than is generally believed, or the riboflavin is present in the diet in a form which is not readily available.

Amino Acid Needs of Poultry

Experiments show that the amounts of 7 of the important constituents of proteins—the amino acids leucine, valine, isoleucine, phenylalanine, histidine, threonine and arginine—are present in adequate quantities in most poultry rations. The amounts, however, of 3 others—tryptophan, lysine and methionine—may be low.

The minimum requirement of the growing chick for tryptophan has been established at 0.18 percent of the ration. In other studies, it was shown that even though enough tryptophan was provided by either fish meal or improperly processed soybean meal, all of the tryptophan present was not utilized by the chick.

These results proved that to evaluate the adequacy of the diets, we need to know not only the quantity of an amino acid the animal needs and how much is present in the diet, but also how much is actually used effectively by the animal. The type of processing used also markedly affects the protein quality of the feeds.

Vitamin B_{12} Concentrates for Swine

It has been known for many years that the addition of a

protein concentrate of animal origin to rations containing only vegetable products usually result in an increased growth rate in swine. It has been thought that this was due in part to the presence of unknown substances of vitamin-like nature which have become known as the "animal protein factor." Evidence has accumulated rapidly to show that the increased growth rate which results from feeding materials containing the "animal protein factor" is due largely to the recently discovered vitamin B_{12}.

An all-vegetable ration containing corn, soybean meal, alfalfa leaf meal and minerals was fed to young pigs through the growing-fattening period. Part of the animals were fed a vitamin B_{12} concentrate (Merck and Co.) in amounts equivalent to 1.5 milligrams of the pure vitamin per 100 pounds of feed. In the first experiment, the pigs receiving the vitamin B_{12} made 31 percent greater gains than the pigs in the control group. Also, the pigs on the B_{12} ration required 22.7 pounds less feed per 100 pounds of gain than the pigs on the check ration.

In a second experiment, the control pigs gained an average of 1.46 pounds per day, while the pigs fed B_{12} gained 1.65 pounds per day. The increase in rate of gain due to feeding B_{12} in this experiment was 12.8 percent.

Protein Concentrate for Swine

The presence of the "animal protein factor" (vitamin B_{12} and possible unknown vitamins), in meat scraps and tankage makes these products desirable as protein concentrates for swine.

However, pig feeding trials at the Texas Station show that certain batches of tankage or meat scraps may be low in the quality of protein required by fattening pigs. Pigs fed soybean oil meal and cottonseed meal gained 10 percent faster in one trial than similar pigs fed meat scraps as the protein supplement. This particular lot of meat scraps was low in tryptophan, the same amino acid that is deficient in corn.

Since it is possible to get a batch of tankage or meat scraps that may be low in tryptophan, it is safer to feed a mixture of two or more feeds for the protein supplement. This is why, in some cases, a feeder will get better results when feeding pigs a mixture of tankage, cottonseed meal and alfalfa meal for the protein supplement than when feeding tankage alone.

The use of high quality protein feeds in pig rations is one of the best means of efficient utilization of grain in balanced rations.

Vitamin A Requirements for Swine

All farm grains (except yellow corn) are deficient in vitamin A. When brood sows or growing pigs are fed rations deficient in

vitamin A, the pigs develop lameness, lose control of their hind legs, and brood sows may farrow weak, malformed pigs.

Good results were obtained when 1,800 units of vitamin A (as green alfalfa leaf meal) were added to each pound of feed in the ration for brood sows. For growing and fattening pigs, 900 units of vitamin A per pound of feed gave good results.

Green pasture is one of the best and most economical sources of vitamin A for brood sows, boars and pigs of any age. Cod liver oil and other fish oils are also good sources of vitamin A.

Sorghum By-products for Feeding Swine

New feeds available for swine include grain sorghum gluten feed and gluten meal. These are by-products from the manufacture of starch and other products from grain sorghum.

Two experiments show that these products may be used as a part of the protein supplement for swine rations.

These sorghum by-products were compared with soybean meal. The pigs getting soybean meal gained 15 percent more per day than the lot getting 30 percent gluten meal in the supplement, and gained 31 percent more than the lot getting 40 percent gluten meal.

It was found that sorghum gluten meal (like corn gluten meal) is deficient in lysine, and is also low in tryptophan. For this reason, it may be more profitable to replace a part of the grain with these products instead of replacing a part of the protein supplement.

Effect of Processing on Nutritive Values

Increasing industrial consideration has been given to solvent extraction as a manufacturing procedure for the extraction of cottonseed oil. Animal feeding trials showed that the nutritional value of the meal varies considerably with the type of processing used.

It was found that meal made by a special process using isopropanol alcohol as a solvent had superior nutritive value.

Two experiments were conducted with the special process meal in growing fattening rations for pigs. A protein supplement composed of 80 percent isopropanol-extracted cottonseed meal and 20 percent alfalfa leaf meal was compared with a mixture of 80 percent soybean oil meal and 20 percent alfalfa leaf meal. The pigs averaged 63 pounds at the beginning of the experiment.

Those fed the cottonseed meal, in the first experiment, made an average daily gain of 1.68 pounds, as compared with 1.67 pounds for the pigs fed soybean meal.

The alcohol solvent must be thoroughly removed from the

meal before feeding it to pigs, otherwise, according to the second experiment, such meal is unpalatable to pigs. In this experiment, pigs fed soybean meal made an average daily gain of 1.83 pounds, while the pigs fed isopropanol-extracted cottonseed meal gained 1.60 pounds per head daily. It is believed that if the meal had been thoroughly aerated before feeding, the pigs would have consumed more feed, which would have meant greater gains. The gossypol content of the cottonseed meal was 0.003 percent.

Cottonseed meal is generally not included in rations for laying hens, except in very small amounts, because of its tendency to cause discoloration of the eggs during storage. Tests in which hens were fed 20 percent isopropanol-extracted cottonseed meal showed no discoloration of the eggs after storage periods of 3 to 6 months. Ninety percent of the eggs from hens in a control group, which was fed 20 percent commercial hydraulic cottonseed meal, were discolored after 6 months storage.

Legume Seeds as a Source of Protein

Southern peas (blackeye peas) are high in protein and an important food in the South. Very little information is available concerning the nutritive value of the protein of this legume.

Southern peas were compared with lima beans, pinto beans, English peas and egg white as a source of protein for growth, using rats as the test animal. Egg white was used as a control because it is recognized as a protein of the highest quality. Cooked lima beans were a fair source of protein, but a very poor source when fed raw. Southern peas were equal to cooked lima beans when fed either raw or after cooking, but the raw peas had a slightly higher nutritive value than the cooked peas. English peas were superior to the other legumes and, like Southern peas, the raw peas were slightly superior to the cooked peas.

These data show that over-cooking should be avoided when peas are prepared for human consumption. Raw pinto beans were a very poor source of protein; the cooked beans, although much superior to the raw beans, had a lower nutritive value than any of the other legumes.

The addition of 0.2 percent methionine (an essential amino acid) increased the nutritive value of the protein of the legumes 2 to 5 times. Lima and pinto beans and English peas were superior to egg white after the methionine was added. Southern peas plus methionine were superior to Southern peas alone, but two other essential amino acids, tryptophan and lysine, had to be added before the Southern peas were equal to egg white.

A diet composed of Southern peas or other legume seeds as the main source of protein would be adequate for rapid growth

if it is supplemented with the amino acid methionine, or some protein, such as meat or eggs, that is rich in this amino acid.

The Nutritive Value of Meat

Rations composed of wheat and milk, previously described as adequate for the rat, improved markedly when part of the wheat in the ration was replaced by meat.

Not only was the growth rate of the rats improved when meat was added, but also the reproduction and lactation performance. The percentage of young weaned was only 60 percent without the addition of meat, and 85 percent when meat was added. The weight of the young at weaning was also increased when 25 to 40 grams of meat were added.

Studies are underway to determine whether the supplemental value of the meat is due to the superior quality and quantity of the protein or to unknown vitamins contributed by the meat.

Interrelationships of Essential Nutrients

It is known that the nutritional requirement for nicotinic acid, one of the water-soluble vitamins, is modified by the amount of protein in the ration. Recent studies showed that the conversion of the amino acid tryptophan to nicotinic acid takes place only when the ration is adequate in other vitamins. For example, if insufficient vitamin B_6 is present, the animal cannot synthesize nicotinic acid from tryptophan.

Other experiments showed that when tryptophan was injected into developing chick embryos, nicotinic acid was formed. This proved that the conversion of tryptophan to nicotinic acid can occur within the tissues and in the absence of bacteria.

These observations aid in clarifying the interrelationships of essential nutrients. It has been shown that a large number of animals require little or no dietary source of nicotinic acid when high protein diets, which contribute tryptophan, are fed.

Thus, the amount of dietary nicotinic acid needed by pigs, chicks, dogs and other animals is markedly influenced by the level of protein (tryptophan) in the diet. Also, when ample nicotinic acid is provided, the tryptophan can then be used more effectively to build body protein since it is not needed as a precursor of nicotinic acid.

Role of Magnesium in Nutrition

A new chemical method was developed for the determination of magnesium in blood and other body tissues. This affords new approaches to a study of the role of magnesium in animal nutrition.

The utilization by the animal of magnesium in the wheat plant and various magnesium salts was investigated. Magnesium

in the young, growing wheat plant is utilized by the animal to about the same extent as magnesium oxide. Magnesium is somewhat less efficiently utilized by the animal than is magnesium sulphate or magnesium carbonate. The requirement of the animal for magnesium appears to be between 200 and 300 parts-per-million of diet. Most mixed rations would provide an adequate amount of magnesium.

Magnesium is essential for the nutrition of the rabbit. In its absence, rabbits become very nervous and frequently have convulsions, Figure 45.

A high level of potassium in the feeds does not appear to interfere with the utilization of magnesium. In the young, growing wheat plant, potassium levels have been found as high as 3.5 percent.

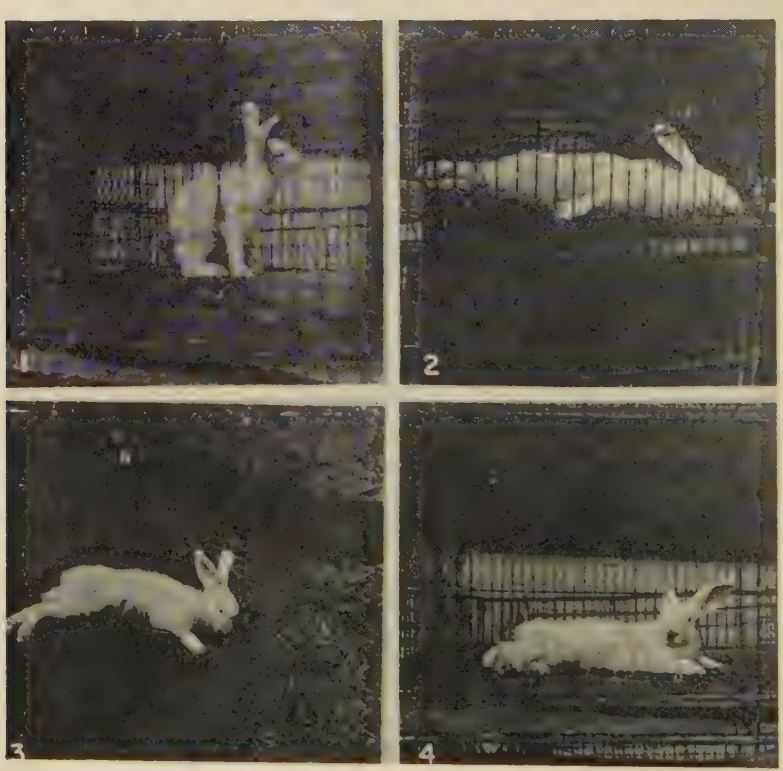

Figure 45. 1. Magnesium-deficient rabbit, apparently normal in appearance before convulsions. 2. The same rabbit immediately after the onset of convulsions induced by the sound of an air blast. 3. The rabbit immediately following the cessation of convulsions. 4. About 5 minutes after the convulsions, the rabbit showed progressive recovery.

Water on the Brain

Hydrocephalus (water on the brain) has been produced in infant rats through inadequate maternal nutrition. The mothers received a diet that contained all the nutrients known to be essential for normal growth. The females bore normal litters and weaned 50 to 55 percent of their young. However, approximately 1.5 percent of the young developed hydrocephalus. A large number of them died within 24 hours after birth. It was suspected that some of these might have had hydrocephalus.

Brain hemorrhages occurred in 52 percent of the young when lard and vitamin K were omitted from the diet used in the hydrocephalus studies. The hemorrhage did not occur if either lard or vitamin K was added. This is the first time brain hemorrhages have been produced in infant rats as a result of an inadequate maternal diet.

This observation supports the view that the cerebral hemorrhages observed in 20 percent of the 128,000 infants who fail to survive each year in the United States is probably caused by a deficiency of vitamin K in the diet of the mother.

Nutritional Requirements of the Cotton Rat

The cotton rat is a very valuable animal for studies on poliomyelitis and tooth decay. Studies were conducted to determine its nutritional requirements, particularly of the B vitamins. It also requires additional factors present in liver concentrates for rapid growth and for successful reproduction and lactation.

The reproduction and lactation performance was not equivalent to that obtained when stock rations were fed. This suggests that factors in addition to those in liver are needed by this animal.

It was found that the water soluble vitamins—biotin, riboflavin and folic acid—are synthesized in the intestine of the cotton rat. The presence of lactose in the ration promotes the synthesis of these important nutritional factors.

Experiments showed that excessive amounts of lactose or galactose (70 percent of the ration) are toxic to the cotton rat. These animals were somewhat more resistant to galactose toxicity than the white rat.

B Vitamins Do Not Increase Milk Flow

The feeding of large amounts of synthetic thiamine, riboflavin, nicotinic acid and pantothenic acid to dairy cows did not significantly increase the amounts of these vitamins in the milk. The apparent explanation is that most of the vitamins are destroyed in the digestive tract of the cow. Practical application of these findings indicate that the B vitamins added to rations for dairy cows have little, if any, value.

Figure 46. Line-up of Texas Station Jerseys that have produced over a ton of butter

Dairy Industry

DAIRY HUSBANDRY

The New Dairy Husbandry Set-up

A new dairy husbandry unit is being established. When the buildings are completed, the research and teaching herds will be operated as a single unit. The department will use the present F&B milking barn as an artificial breeding center. Semen shipments will be continued to various breeding associations in the State. Research will be conducted in the care and handling of semen as well as in the feeding and management of the herd sires.

The new milking unit will be modern in every respect. The cows will be fed their grain in an adjoining barn before moving into the milking stalls. Approximately 160 cows will pass through the milking unit twice a day. Three men operating six combine milking machines will handle at least a cow per minute. The milk will pass directly from the cow to glass weighing bowls, and from there—still under vacuum—it will move to a releaser over the surface cooler in the milkhouse. After being cooled quickly to 40° F., it will pass immediately into a stainless steel, insulated tank mounted on a four-wheeled trailer. Thus, without any handling in cans or buckets, the milk will be taken

from the cow to the creamery where, after pasteurization and bottling, it will be ready for the College dining halls.

Specially designed experimental feeding stalls will be built in one end of the grain feeding barn adjoining the milking unit. Cows on feeding experiments can be milked in the same manner as the cows in the general herd. But, after milking, they will be moved back into their stalls instead of entering the lots and shelter barns where the general herd will receive its hay and silage in open feeding racks.

Experimental Jersey Herd Is Outstanding

Thirteen Jerseys in our experimental herd have each produced more than a ton of butterfat, Figure 46.

Actually, the 13 cows have given a grand total of more than 449 tons of milk and 22 tons of butterfat. They have produced enough milk to give every person in a community of 2,300 people one pint of milk a day for a year. At current wholesale prices, their milk would bring $70,510.03. Based on the average price received by the Station for their milk and the average price paid for feed during their lives, this group returned $36,481.00 profit above feed costs, plus the value of their progeny.

These cows range in age from 17 to 8 years. Extremes in production ranged from 130,391 pounds of milk and 5,892 pounds of butterfat to 50,392 pounds of milk and 2,372 pounds of butterfat.

The two cows at the top of the list have each produced more than 50 tons of milk and almost 3 tons of butterfat. The first cow, T.A.E.S. Fairy Tormentress, age 17, is a tested dam with two Silver Medal daughters, Figure 47. She has given the Station six daughters, the last of which arrived a few days after the picture for Figure 47 was taken. The combined production of this cow and her daughters already totals over 166 tons of milk and 7.3 tons of butterfat. Two of her sons were sold to Texas dairymen.

The second cow on the list, Forfarshire's Gr. Daughter 2d, age 15, is the dam of three sons that have been or are being used in Texas herds, including the College bull stud. She is also the dam of Forfarshire's Gr. Daughter B, one of the comparatively young cows with over a ton of butterfat to her credit. During her 13 productive years, her large mammary veins have helped carry away from her udder approximately 70,000 tons of blood from which the materials for milk secretion were taken. The udder is still soft and pliable, but areas of fibrosis can be felt that were left by attacks of mastitis from which modern medicine has helped her rid herself.

The only thing that prevents several of the cows on the list from being recognized by the American Jersey Cattle Club as

Figure 47. T.A.E.S. Fairy Tormentress, 1015398. She and 4 of her daughters have produced 166 tons of milk and 7.3 tons of butterfat.

official "Ton of Gold" cows is that not all their records have been made under the supervision of the Club.

To appear on the list of "Ton of Gold" cows, a cow must have produced at least 2,000 pounds of butterfat within 4 years while on either Register of Merit or Herd Improvement Registry testing.

Better Dairy Cattle for the South

Texas has its own phase of a regional breeding project designed to produce better dairy cattle for the South.

Jersey and Brahman cattle are being crossed at College Station to determine whether the heat and parasite-tolerant qualities of the Brahman can be combined and fixed with the high milk-producing qualities of proved lines of the Jersey breed to produce a strain better adapted to Texas conditions.

Efforts also will be made to determine whether crossbred individuals, as such, have superior merit.

This experiment may continue for as long as 25 years.

The breeding herd comprises 15 purebred Jersey heifers and 30 Brahman heifers. All have been bred to proved Jersey bulls. The Jersey females and their offspring will be carried as controls to check the progress of the experiment. The crossbred

heifers produced will be backcrossed to the same Jersey bulls used on the heifers produced from the straight Jersey matings. Later generations of the individuals of mixed blood will be bred together in an effort to fix the desired characters.

Wheat Germ Oil No Cure for Sterility

A study was made of the effect of feeding wheat germ oil to dairy cows who apparently were partially sterile. The oil was fed according to the manufacturer's instructions for 90 days, but the treated cows had no better conception record than similar cows which did not receive the oil.

Two lots were made of 32 cows whose records indicated they were "slow breeders." Wheat germ oil was fed to one lot. Of the 16 cows receiving the oil, 7 conceived within the 90 days, 2 conceived within an additional 60 days, and the other 7 cows were sold after failure to get with calf. Twelve of the control lot conceived during the 90-day experimental period; the other 4 were sold as non-breeders. The 32 cows were bred an average of 4 times.

It is believed that the conceptions which occurred in both lots were due to natural recovery and cannot be credited to the treatment with wheat germ oil. There is no explanation for the fact that the controls showed a better conception rate than the experimental animals. The lots were divided at random, and the previous breeding records of the control lot were not appreciably better than those of the other lot.

Feeding Trials With Dairy Cattle

Studies were made in the feeding of dairy calves on milk substitutes, the value of sorghum grain by-products for dairy cattle, the feeding of organic insecticides to cows in milk and the use of citrus molasses in dairy rations. Only preliminary reports are available on any of these projects.

The third of a series of feeding trials on the value of sorghum gluten feed and sorghum gluten meal as protein supplements for dairy cattle was completed. In two of these trials, sorghum gluten meal was compared in double-reversal feeding experiments with corn gluten meal, which is widely used as a feed for dairy cattle.

Two lots of five producing cows each were used in the 90-day feeding trials. The lots were balanced for age, stage of lactation, daily production and body weights at the beginning of the experiments. All groups received the same roughage ration of fair quality grass hay and silage with no pasture.

The grain rations used were:

First trial—Ration 1: 450 pounds ground sorghum grain; 100 pounds ground oats; 150 pounds wheat bran; 300 pounds

corn gluten meal; and 10 pounds each of bone meal, salt and ground limestone. Ration 2 was the same as ration 1, except 300 pounds of sorghum gluten meal replaced the 300 pounds of corn gluten meal.

Second trial—Ration 1: 360 pounds ground sorghum grain; 140 pounds ground oats; 100 pounds wheat bran; 370 pounds corn gluten meal; and 10 pounds each of bone meal, salt and ground limestone. Ration 2 was the same as ration 1, except 370 pounds of sorghum gluten meal replaced the 370 pounds of corn gluten meal.

The total protein in each of the grain rations used in the first trial was 20 percent, and the two rations used in the second trial contained 22 percent protein.

Production of the cows, in terms of 4 percent fat-corrected-milk, was:

Average daily milk production—first trial: ration 1, 18.60 pounds; ration 2, 17.40 pounds—second trial: ration 1, 24.50 pounds; ration 2, 23.50 pounds. Averages of two trials were: ration 1, 21.50 pounds; ration 2, 20.50 pounds.

Average decline in daily milk production per week—first trial: ration 1, .42 pound; ration 2, .91 pound—second trial: ration 1, .85 pound; ration 2, 1.28 pounds. Averages of two trials were: ration 1, .63 pound; ration 2, 1.10 pounds.

On the basis of these two trials, it is evident that the sorghum gluten meal is approximately 90 percent as efficient as corn gluten meal for supplementing dairy rations. If corn gluten meal was worth $4.00 per hundred pounds, the sorghum gluten meal would be worth $3.63 per hundred pounds. It should be noted that in a double-reversal feeding experiment, all of the cows are fed each of the rations at some period during the experiment. Therefore, the differences in production shown represent differences in the production of 20 cows when fed the two rations and not differences between cows or groups of cows.

In another feeding trial, the sorghum gluten feed was compared with cottonseed meal as a protein supplement in dairy rations. However, sorghum gluten feed contains only 25 percent total protein. To completely balance the ration with it as the only protein supplement would have required excessive amounts of the sorghum gluten feed. Therefore, the percentage of sorghum gluten feed in ration B was limited to 35.

The rations used were:

Ration A: 360 pounds ground sorghum grain, 140 pounds ground oats, 100 pounds wheat bran, 370 pounds cottonseed meal, and 10 pounds each of bone meal, salt and ground limestone.

Ration B: 300 pounds ground sorghum grain, 70 pounds wheat bran, 50 pounds ground oats, 200 pounds cottonseed meal, 350 pounds sorghum gluten feed, and 10 pounds each of bone meal, salt and ground limestone.

Chemical analyses indicated that each ration contained 20 percent total protein. The production of the cows on the two rations showed no difference in their feeding value.

Average daily milk production per cow in terms of 4 percent fat-corrected-milk, was: ration A, 20.20 pounds; ration B, 20.30 pounds. Average decline in daily milk production per week was: ration A, 1.00 pound; ration B, .88 pound.

Milk Substitutes in Calf Feeding

Milk substitute diets using dried whey for young dairy calves were studied during 1948-49.

Jersey and Holstein bull calves weaned at 21 days of age from whole milk to a gruel mixture containing 20 percent dried whey grew significantly slower than comparable calves fed longer on whole milk. The gruel-fed calves carried rough coats and appeared undernourished until they were at least 3 months old. Comparable calves fed whole milk longer had sleek coats and appeared thrifty throughout the experimental period.

The grain mixture which proved the best contained 10 parts alfalfa leaf meal, 12.5 parts cottonseed meal, 20 parts dried whey, 20 parts ground corn, 12.5 parts soybean meal and 25 parts wheat gray shorts. Feeding dairy calves this mixture in gruel form, beginning at 21 days of age, was more economical than feeding a limited amount of whole milk and dry calf-starter. There was a saving in cost of feed to 6 months of age of $17.80 for Jersey calves and $13.10 for Holstein calves. Adding 12 percent dried skim milk powder to the formula considerably increased the cost of mixture and did not improve the growth-promoting properties.

Gruel feeding required more time than limited whole milk feeding. Proper management was also a more critical factor for success with the gruel feeding plan.

The limited whole milk plan of feeding dairy calves, which served as a check in the testing of the gruel diets, deserves special mention. This plan gives the calves a good start on whole milk, then weans them to a dry calf-starter at an early age. About 350 pounds of whole milk are required for a calf. Holstein calves are started on 8 pounds of milk per day. The daily milk ration is increased to 10 pounds per calf the second week. The amount of milk fed daily the fourth week is reduced to 8 pounds, and reduction is continued at weekly intervals until the 8th week when milk is removed from the diet. As the milk is reduced, the calf is encouraged to consume more dry grain and choice

alfalfa hay. The same plan is followed for Jersey calves, except 7 pounds of milk is the maximum daily ration and the period of milk feeding is continued to 10 weeks. When milk feeding is done on this schedule, calves are eating 2 to 3 pounds of dry grain and about the same amount of hay daily at the time they are weaned from milk. Our calves seldom bawl or show other signs of distress when milk feeding is discontinued. Growth is not interrupted by the change to a dry diet.

The success of a limited whole milk plan of feeding young calves depends upon supplying the right kind of grain mixture. The starter must be palatable, highly digestible and adequate in protein. The formula developed by the Texas Station meets these requirements. In addition, the ingredients are obtained readily and are relatively low in cost. Our mixture contains 30 parts ground sorghum, 40 parts cottonseed meal, 10 parts wheat bran, 10 parts ground oats, 10 parts commercial dried whey, and 1 part each of bone meal, salt and ground limestone.

Figure 48 shows a group of growthy, sleek-coated Jersey heifer calves raised on the limited whole milk plan.

Figure 48. Jersey calves grown on the limited whole milk plan.

Chlorinated Camphene Apparently Not Toxic

In this experiment, five grade cows were given daily oral doses of chlorinated camphene (toxaphene) for 3 months. Three of the cows received .5 gram daily and two received .2 gram. Samples of the milk were analyzed at 10-day intervals.

Their analyses showed that the organic chloride content of the milk from these cows was not increased by feeding the chlorinated camphene. This indicates that the insecticide apparently was not secreted in the milk. However, it is possible that metabolic products of the insecticide are secreted; if so, these products may be toxic to humans or animals.

Further work has been planned to explore this possibility.

Eliminating Mastitis

A complete physical examination of the udders of the Station cows was made in 1947. Forty-five percent of the cows of milking age showed symptoms of mastitis. Steps were taken immediately to bring the disease under control. Only 4 percent of the cows now have mastitis, and these are isolated from the other animals. Our experience during the past 2 years suggests the following recommendations for controlling this disease:

All animals of milking age should be examined carefully by a competent veterinarian for scar tissue in the udder. All those with considerable induration (scar tissue) should be removed from the herd.

A strip cup should be used on each quarter at each milking. Any cow showing lumps, strings or off-colored milk should be milked after the clean cows have been milked. Treatment of affected cows should start immediately.

Other tests, such as the brom-thymol blue, Hotis test or, better still, microscopic tests should be conducted as frequently as possible. These tests may indicate the presence of mastitis in the udder before the disease can be detected in the strip cup. The principal advantage of the strip cup as a test for mastitis is that it can be used at every milking. Early detection is highly important in the treatment of mastitis. In most instances, it is advisable to secure the services of a veterinarian.

The Station is using a combination dose of penicillin and sulfamerizine. Cows which have had mastitis should be treated again when they are turned dry, and the medicine left in the udder.

In herds where mastitis is a problem and milking machines are used, the teat cups of the machine should be soaked in a solution containing 250 parts-per-million of available chlorine after each cow is milked. To do this, it is necessary to have an extra set of teat cups, claw and pulsator for each two machine units. Before immersing the cups in the chlorine solution, they should be rinsed in clear water. If cows are milked by hand, the milker's hands should be washed in soap before each cow is milked.

Udder injuries and the introduction of infection into the udder can be reduced by the elimination of water and mud holes in the pastures and lots, sharp snags and brush, high door sills, slick floors that may cause falls, broken fences and gates, and pouring or milking milk from infected udders onto the floor or gutter.

V-type Hay Rack Prevents Waste

The Department is demonstrating a V-type hay feeding rack that has not been widely used in this section. The plans for a similar rack have been available for several years (hayrack plan No. 345), but have received only limited usage, apparently because the value of the rack has not been realized.

As can be seen in Figure 49, the cow does not pull the hay from the rack as she does when eating from the common slatted rack because she eats with her head completely inside the rack, and because the V-shaped openings prevent her dragging blocks of hay from the rack. Therefore, the amount wasted is unusually small. It has been demonstrated at the research dairy that 5 calves eating hay from an ordinary slatted rack will waste more hay than 50 cows eating from 3 of the new racks. We have also observed that while using these racks it is no longer necessary to tear up blocks of baled hay for the cows as we used to do with other type racks. Eight of the new racks were built by the Department in 1947, five at the College dairy and three

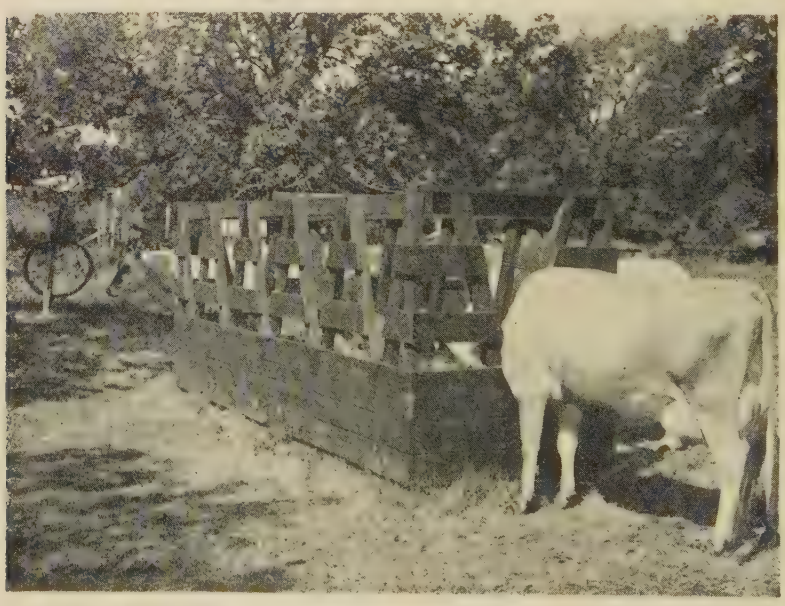

Figure 49. V-type hay rack designed to prevent feed waste.

at the research station. We are convinced that the hay and labor saved has already paid the cost of construction, which amounted to approximately $50 per rack. However, this type rack is not generally recommended for cows with horns.

DAIRY MANUFACTURES

Oxidized Flavor in Milk

A troublesome off-flavor in milk occurring mostly during the winter and known as "oxidized," "papery," "cardboard," "metallic," "emery" and perhaps by other names, has been studied for 2 years.

It has long been known that this flavor may result when cows are not eating green feed, and particularly if non-pasture milk is handled in rusty or copper-exposed equipment. It is well established that individual cows, and even the four quarters of the same cow, show marked differences in the incidence of oxidized flavor. The intensity of the flavor is also quite variable. Unfortunately, the flavor most frequently occurs in the cleanest milk from non-infected cows.

This presents a difficult problem for the raw milk producer-distributor who is making a special effort to produce milk within certain bacteria count limits. One possible solution is to eliminate the milk of cows showing the oxidized flavor.

When raw milk has oxidized flavor, pasteurization intensifies it unless abnormally high temperatures are used. The high-temperature, short-time system of pasteurizing has, however, overcome the flavor in some instances where the holding system made it worse. If milk susceptible to becoming oxidized is pasteurized as well as homogenized, the development of the flavor is prevented.

While there ordinarily are large numbers of leucocytes in infected udders, there are instances of abnormally large numbers of them in udders in which very few bacteria are found. Milk from such cows may have an oxidized flavor. It is significant that oxidized flavor does not develop in pasteurized, homogenized and clarified milk. While leucocytes are considered to be reducing in their activity, there is a possibility that they are associated with oxidation and oxidized flavor, since pasteurized milk not homogenized or clarified will have a more pronounced oxidized flavor than raw milk. A limited study shows that the theory on leucocytes may be right. However, the work has been done on too small quantities of milk, pending the installation of a continuous centrifuge for the removal of leucocytes. It is expected that considerable information on this subject will be available after the winter of 1949-50 when the centrifuge will be available.

A certain bacteria, not common to udders, has been isolated

from cows whose milk has oxidized flavor. Very few other types can be found when the bacteria is present. The organism is difficult to isolate because it does not respond to standard analytical procedures. When pure cultures of the bacteria are inoculated into milk that is normally free of oxidized flavor, there is no flavor development; when it is inoculated into milk that is susceptible to becoming oxidized, the developed flavor is more intense. It appears, then, that this bacteria is associated with the flavor development in the udder, even though pure laboratory cultures of it do not reproduce the flavor strongly.

Quaternary Ammonium Compounds as Disinfectants

The quaternary ammonium compounds are known to be valuable as disinfectants in several phases of sanitation. They are better in all respects than chlorine. Their use on dairy utensils, however, is forbidden by the Texas State Health Department because of the tendency for users to take advantage of their property of remaining stable in the presence of organic matter. This invites fraud because the quaternary compound can be used as a preservative.

An important point in the use of any disinfectant is its reaction after being diluted to use strength. The type of diluting water is important. The Department is studying the effectiveness of several quaternaries in the presence of waters from various parts of Texas. Results to date indicate that water containing a very low mineral content will inhibit the action of quaternaries. The extent to which any particular mineral substance acts as an inhibitor is not yet known because the chemical analyses have not been completed. *Escherichia coli,* a common milk contaminant, is the test organism.

Statistical Quality Control of Dairy Products

A project is underway to determine if statistical quality control, as practiced in the metal working industries, is applicable to the control of quality in dairy products. Exploratory work in this field has been conducted since June 1, 1949.

Data from five different dairy products manufacturers have been selected and treated statistically to show the degree of efficiency of plant operations. These operations include fluid milk, butter, American cheese and evaporated milk.

Charts were prepared to illustrate how consistently various quality factors are maintained. These charts illustrate quickly whether a process or quality factor is in control. Proper adjustments can be made if the raw material, the operator, the machine or the finished product is defective. If the operation is in control, the operator is discouraged from making unnecessary changes.

The cooperating plants have been enthusiastic, without ex-

ception, about the program. Data are now being sent each week to the project leaders so they may keep the records up-to-date. When these records have been properly evaluated, it is hoped that an instruction manual on the use of the charts can be prepared for distribution to the plants which wish to use them.

Factors Affecting the Quality of Butter

Experiments were conducted on the effect of rations containing hydraulic-extracted cottonseed meal, solvent-extracted cottonseed meal and lecithin on the quality of butter. Six cows were used in a reversal feeding test.

The milk from each cow was collected separately; the cream was separated and churned into butter in a Dazey churn. The butter, after having been salted and worked, was printed, pressed, wrapped in parchment paper and stored in a refrigerator.

The body of the butter was graded by two experienced judges. The Reichert-Meissl number, Polenske number, iodine number, melting point and percent of lecithin were determined on each sample.

Butter made from the milk of cows fed a ration including lecithin had a satisfactory body. In the first trial, butter with a gummy body defect was obtained from the milk of one of the two cows fed a ration including solvent-extracted cottonseed meal, and from one of the two cows which were fed a ration including hydraulic cottonseed meal.

In the reversal trial, butter with a gummy body defect was obtained from the milk of one of the two cows whose rations included solvent-extracted cottonseed meal and from both cows fed hydraulic cottonseed meal. Butter with a satisfactory body was obtained from the milk of the two control cows whose rations contained no cottonseed meal.

This study appears to indicate that the Reichert-Meissl number, Polenske number and melting point of the fat have no significant relationship to the gummy body defect.

A reversal feeding test was then conducted, using six cows and feeding periods of 4 weeks, to determine the effect of adding grain sorghum silage to a ration containing either type of cottonseed meal. Thirty-six samples of butter were made from milk taken at the following intervals: when the cows were on pasture; cows removed from pasture and fed corn gluten meal; 2 weeks after corn gluten meal was replaced with cottonseed meal; 4 weeks after corn gluten meal was replaced with cottonseed meal; 2 weeks after reversal of cottonseed meal feeding; and 4 weeks after reversal of cottonseed meal feeding.

Organoleptic tests for gumminess were made on each of the butter samples by two experienced judges 10 and 20 days after manufacture.

The gummy defect was present in only 1 of the 36 samples examined. This gummy butter was manufactured from the milk of a cow which received sorghum silage and hydraulic-processed cottonseed meal for 2 weeks. The same cow produced normal butter after receiving sorghum silage and hydraulic-processed cottonseed meal for 4 weeks. When experimentally-fed cows received cottonseed meal and no silage, three of the six cows getting solvent-extracted cottonseed meal and five of the six cows receiving hydraulic-processed cottonseed meal produced gummy butter. It appears, therefore, that the addition of sorghum silage to a ration containing either type of cottonseed meal is effective in eliminating the occurrence of gummy butter.

Five samples of butter were made from the milk of cows in late lactation to determine whether such milk has a relationship to the gummy defect in butter. Since only one of the five samples of butter made from the milk of cows in advanced lactation was gummy, it appears that milk produced by such cows has no significant effect on the incidence of gummy butter.

Since the chemical fat constants, such as Reichert-Meissl number, Polenske number and iodine number, are of little value in determining the cause of gummy butter, a fatty acid analysis by means of vacuum fractional distillation is being carried out, Figure 50, to determine whether there is a difference in the composition of normal butter as compared with that of gummy butter.

Figure 50. Determining the lecithin content of butterfat. The apparatus shown is used in making precise determinations of the butterfat content of milk, and for numerous other analyses.

Figure 51. Cotton on the left received 8 applications of toxaphene-DDT spray emulsion for bollworm control and yielded 1,818 pounds of seed cotton per acre in 1949. The cotton on the right was not treated and yielded only 689 pounds of seed cotton per acre.

Entomology

BASIC RESEARCH LABORATORY

Adequate land, housing and greenhouse space for research made possible a greatly expanded basic research program in insect physiology and toxicology. Cultures of insect pests are maintained throughout the year for biological study and as test animals. The laboratory has been equipped with the very newest devices, such as dusting and spraying machines, injection apparatus, controlled temperature and humidity cabinets, scales and cages.

This equipment will serve in the study of insecticides together with insecticidal action on insects. Hundreds of new compounds and combinations of compounds are being tested annually for evaluation in the laboratory previous to being used in field tests.

The new equipment also affords graduate students an apportunity to work on established research projects directly under the supervision of the project leaders.

APICULTURAL RESEARCH LABORATORY

The Apicultural Research Laboratory has recently been moved from San Antonio to College Station. This made possible the consolidation of all entomological research in one area. Necessary apparatus is also being obtained for various phases of research in beekeeping.

INSECT CONTROL

Cotton Insect Control

Tests conducted during the past 3 years proved that several of the new organic insecticides are highly effective against one or more important cotton insect pests, and that combinations of some of these insecticides are effective against all major cotton pests.

Several dust mixtures, 5 percent DDT-sulphur, 5 percent toxaphene-sulphur, 5 percent chlordane-sulphur or 1 percent gamma benzene hexachloride, are effective against the cotton fleahopper. These dusts, consisting of low percentages of the toxic ingredients, are ineffective against other important pests and should be used only for hopper control. Toxaphene and DDT applied as spray emulsions were also effective against this pest.

A 20 percent toxaphene-sulphur or a 3 percent gamma benzene hexachloride-5 percent DDT-sulphur dust proved effective against practically all cotton insects, Figure 52. These dusts gave as good control of the boll weevil as calcium arsenate and better control of the bollworm. Toxaphene-DDT and toxaphene spray emulsions applied at a pressure of approximately 60 pounds, using only 7.5 gallons of spray per acre, gave fair control of the boll weevil and excellent control of the bollworm, Figure 51. The sprays were as effective as the dusts in experiments where bollworms and boll weevils were injurious. Both gave adequate control and yields were increased from 50 to 160 percent.

Applications of the organic dusts or sprays at the proper time and at proper intervals are very important. Either of the dust mixtures or sprays should be applied at 5-day intervals as long as the insect infestation continues. Cotton bollworm control is especially dependent on the timeliness of the applications because the insecticides are more effective against the small worms.

Dust mixtures and spray emulsions containing toxaphene, chlordane or benzene hexachloride, gave excellent control of grasshoppers. As little as 1 pound of toxaphene or chlordane and .3 pound of gamma benzene hexachloride per acre was sufficient to control young grasshoppers but a higher dose was necessary to control the adults.

The contact action of benzene hexachloride was more effective than toxaphene or chlordane. The effective kill of either of the

Figure 52. Cotton on the left received 6 applications of 3 percent gamma benzene hexachloride-5 percent DDT-sulphur dust for boll weevil and bollworm control and yielded 1,417 pounds of seed cotton per acre in 1947. The cotton on the right was not treated and yielded only 721 pounds of seed cotton per acre.

materials represents a combination of contact and stomach poison. Due to its pronounced contact effect, benzene hexachloride gave a quick kill. The materials must be applied under good dusting conditions to obtain the maximum benefit from the contact action.

Several new materials used during 1949 look promising for economical control of grasshoppers.

Laboratory tests indicated that certain environmental factors such as temperature, humidity and sunlight, reduced the toxicity of the organic insecticides. Toxaphene retained its toxicity in the presence of extreme temperatures and humidities better than other organic materials tested.

A large number of new insecticides were tested in the laboratory against such pests as boll weevils, bollworms, aphids, fleahoppers and stinkbugs. Some look promising and will be included in field tests in 1950.

Pecan Insect Control

Several of the new organic insecticides, such as DDT, benzene hexachloride, parathion and toxaphene, proved as good or

better than the standard treatments of lead arsenate or nicotine sulphate against the pecan nut casebearer.

DDT and parathion gave a higher percent control of the nut casebearer than any of the other materials. Parathion, however, is extremely toxic and dangerous to operators applying it. Three pounds of 50 percent wettable DDT powder per 100 gallons of water gave about 98 percent control when thorough applications were made. Mite damage may develop following DDT applications, but the mites have been controlled with 6 to 8 pounds of wettable sulphur per 100 gallons of water. Indications are that the sulphur may be applied with the DDT to prevent this mite damage. Further tests will be necessary to determine this.

Other materials such as lead arsenate, nicotine sulphate, benzene hexachloride and toxaphene, gave satisfactory control of the casebearer when thoroughly applied at the right time. Trees sprayed with nicotine had more and greener foliage at harvest time than trees receiving other treatments.

All insecticides tested showed a marked increase in yields over untreated trees in years when the infestation of the casebearer was heavy. The various insecticides tested in 1947 resulted in an average gain of 70 pounds per tree over untreated trees.

Neither nicotine sulphate nor benzene hexachloride in combination with DDT or lead arsenate was effective in preventing plant lice increases. These aphicides do not remain toxic long enough to prevent increases of plant lice 6 to 8 weeks after lead arsenate or DDT is applied.

Corn Earworm Control

Recent experiments at Weslaco showed that 2 applications of an emulsion containing 1 percent DDT, 10 percent of a U. S. P. white mineral oil (80 to 90 Saybolt seconds viscosity) and 89 percent water, applied as a spray to individual ears, gave good control of the corn earworm. The spray applied under a pressure of 35 pounds or more should be directed at the corn silk and applied at approximately one-fourth teaspoonful per ear. The first treatment should be applied when approximately 10 percent of the silks are showing, with the second application following in 2 or 3 days. Garden sprayers, or any other type of sprayers adapted for hand applications, can be used.

Single applications of 1 percent DDT in mineral oil, applied in this manner after the ears have been fertilized, gave good control of the corn earworm. Application of this DDT oil solution before fertilization will prevent the development of the ear.

Experiments were conducted on the application of the DDT-

oil emulsion spray with a fixed boom sprayer. Good control of earworms was obtained with 2 applications of 10 percent oil emulsion containing 1 percent DDT when applied at the rate of 35 gallons per acre. The sprayer was arranged so that 4 nozzles were directed at the corn silks of each row. The first treatment should be applied when not more than 10 percent of the plants are showing silks, with the second application 2 or 3 days later.

Airplane dusting with 5 percent DDT dust failed to give satisfactory control of the corn earworm.

Onion Thrips Control

Experiments conducted at the Weslaco station showed that a combination of 2.5 percent DDT and 0.5 percent gamma benzene hexachloride is more effective than a 5 percent DDT dust in controlling onion thrips. Other experiments showed that a combination of 5 percent chlordane with 5 percent DDT was superior to the 5 percent DDT dust alone. Parathion and toxaphene were also effective as controls for the onion thrips. Chlordane dusts reduced the thrips population immediately after application but lost its effectiveness in 2 or 3 days.

Insect counts taken periodically after dust applications showed that no insecticide used gave protection for more than about 7 days. The greatest thrips population on onion plants occur before the thrips injury is detected. One experiment showed that the greatest yield of onions was obtained when the control program was started before thrips injury became evident on the plants.

Vegetable Aphids Control

Turnip and mustard greens must be practically aphid-free when sold for either fresh market or canning purposes. Experiments at Weslaco showed that a 1 percent rotenone dust can be used safely in eliminating turnip aphids. A 1 percent parathion dust is also effective in cleaning up heavy aphid infestations. Tests showed that this toxic material is absorbed by turnip and mustard greens. Benzene hexachloride and lindane dusts are also effective in reducing aphid infestation, but these materials imparted an objectionable odor to greens, especially noticeable when canned. A 3 percent nicotine dust is ineffective in this area, due to low temperatures during the regular turnip growing season.

Aphids on radishes can be controlled easily with either a 1 percent rotenone dust or a 3 percent benzene hexachloride dust.

Lettuce aphids can be controlled with a dust mixture of 0.1 percent pyrethrins and 1 percent DDT (impregnated dust). Experiments also showed that 1 pint of 20 percent tetraethyl pyrophosphate in 6 gallons of water per acre applied by airplane

will give control of the red lettuce aphid. Aphid control must be started before the lettuce begins heading.

Cabbage aphids were controlled effectively with either a 1 percent tetraethyl pyrophosphate dust or a 3 percent gamma benzene hexachloride dust.

Melon aphids were effectively controlled during warm weather with a 3 percent nicotine dust, but this material was effective for only 3 or 4 days. A 1 percent lindane dust was not as effective as the 3 percent nicotine dust 24 hours after application, but observations showed that the lindane dust was superior to the nicotine dust 7 days after treatment.

Rhodes Grass Scale Control

An intensive research program to save many important South Texas lawn and pasture grasses from destruction by Rhodes grass scale got underway early in 1949 at the Weslaco and Winter Haven stations and on the King ranch.

Since it was first identified in Texas near Kingsville in 1942, the Rhodes grass scale has spread over much of South Texas, Figure 53. It has been found as far north as an irregular line running from Eagle Pass through San Marcos to Houston. The

Figure 53. A new pest of pasture and lawn grasses in the United States, Rhodes grass scale, has spread over all of South Texas. The soft-shelled, white scales, enlarged about four times in the above picture, are found at the crowns and occasionally at the nodes of grasses, and just below the surface of the ground.

most rapid spread has occurred in the past 3 years. At least 29 important pasture and lawn grasses are known to be attacked by the insect. Grasses which seemed to be preferred are Rhodes, Johnson and St. Augustine. Bermuda and Buffalo grasses are also included among host plants.

The many lines of investigations to be followed will first feature biological and chemical control studies. Another insect (*Anagyrus antoninae*), which preys on the scale, was imported from Hawaii by refrigerated air express, increased at the Weslaco station and turned loose in observation plots. The possibility of bringing the scale under control with this parasite will first be determined.

Cultural studies and tests with insecticides on small plots and in small cages are underway at the Winter Haven station. The life and seasonal history of the scale are also being studied at Winter Haven to determine the interval between the egg and adult stages, and the number of generations of the insect grown in a single season.

In every survey made, the scale has been found on both native and imported grasses. Some grass plants, notably Angleton grass, apparently do not suffer injury from this insect. Other grasses are thought to have varying degrees of resistance to its attack. A study is being made for the classification of grasses offering any promise of freedom from scale injury.

There is some indication that chemicals may be used successfully in the control of Rhodes grass scale on small areas such as lawns, parks and golf courses. It is doubtful that such measures would be either practical or economical on large range areas.

Home Economics

Research in home economics falls into only two of the several phases of this subject-matter field—textiles and clothing, and foods and nutrition.

Textiles and clothing studies dealt with the physical properties and characteristics of cotton fibers and fabrics as influenced by environment and methods of handling, and with serviceability of garments made from cotton of known history.

Some foods and nutrition studies dealt with certain nutritive values of selected foods. For example, the B vitamins in meat as influenced by roasting, stewing and canning; in Blackeye peas as affected by canning; and with the relative values of enriched and unenriched cornmeal preparations.

The vitamin C values of turnip greens, cabbage, Blackeye and Long Pod Cream peas in the raw stage and as ready to eat have been studied, also the retention of vitamin C in canned Blackeye peas.

Other studies dealt with safe methods of canning Blackeye peas; the effect of fertilization, weather, soil and variety upon the mineral content of selected vegetables; and the influence of freezing upon palatability and food value of poultry.

Body measurements of school children in different occupational groups comprised another investigation.

The three reports following illustrate the general nature of home economics studies.

Vitamin C in Southern Peas

Two varieties of Southern peas (edible cowpeas) in five stages of growth were picked on the same day from each of two plantings in each of two crops, one of Long Pod Cream and the other of California No. 5. Figure 54 shows the relative widths and lengths of the five stages. Peas in the shelling stage were of practically the same size but were easily sorted, according to the color of the pod, into three classes—all green, green with yellow streaks and all yellow. Small peas could be seen and felt in the large snaps but not in the small ones.

The raw peas in the all-green pods had the highest amount of vitamin C. Small snaps were so little higher in this vitamin than the large ones that these two stages from the second crop were combined for analysis. Fresh raw peas, both snaps and those shelled from the yellow-streaked pods, had about two-thirds to three-fourths as much vitamin C as the peas shelled

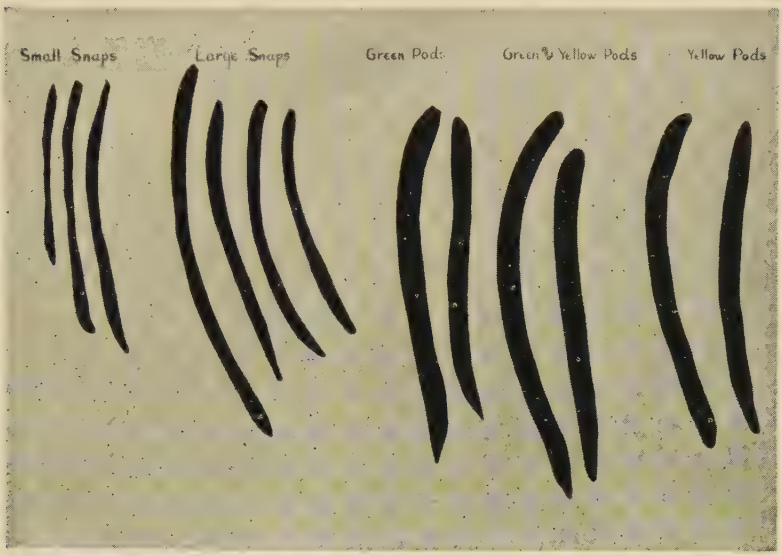

Figure 54. Five stages of growth of Southern peas used in studies to determine the amount of vitamin C at each stage.

from the all-green pods. Peas from the all-yellow pods were only about one-third to one-half as rich in vitamin C as those from all-green pods.

After cooking in four-serving amounts (300 grams or 2 cups raw), the snaps and the peas shelled from both the green and the yellow-streaked pods retained about one-half as much vitamin C as in the corresponding raw stage. Including the cooking liquor, the content of vitamin C was about two-thirds to three-fourths as much as in the raw peas. When cooked on the day picked, one serving of the peas plus liquor would have provided from one-eighth to one-fourth of the daily amount recommended by the Food and Nutrition Board of the National Research Council for a physically active man.

Canning Blackeye Peas

Blackeye peas are one of the favorite foods of Texas people. Many peas are canned at home. Since they are in the low-acid group of vegetables, there is danger of spoilage by *Clostridium botulinum*. This is an organism which produces a poison so potent that only a tiny amount is needed to cause death to a human being. Consequently, killing temperatures must be maintained long enough inside the containers of food to destroy it. The processing times needed to do this have been determined. Peas of three different maturities were studied but the maturity stage was not an important factor.

Recommended processing periods at 10 pounds pressure are:

Hot Pack

Glass jars:	Pints	35 minutes	Tin cans:	No. 2	30 minutes
	Quarts	40 minutes		No. 3	35 minutes

Cold Pack

Glass jars:	Pints	35 minutes	Tin cans not recommended
	Quarts	40 minutes	

The actual temperature at the coldest spot in the jar of food is recorded on the chart at the right in Figure 55. This is done

Figure 55. Removing a load of experimental jars of Blackeye peas from the pressure cooker. Killing temperatures must be maintained to destroy an organism, *Clostridium botulinum*, which produces a deadly poison.

by means of thermocouples. The thermocouple wires are led from the recording instrument through stuffing boxes in the lid of the pressure cooker and through other stuffing boxes in the lid of the container. These stuffing boxes prevent the escape of steam. A full cooker load of containers is used each time.

Serviceability of Garments

Fifty-five men are cooperating in a serviceability study by each wearing 7 white broadcloth shirts made from cotton which differs in variety, region where grown, season grown and method of harvesting. The purpose of the study is to see if these factors affect the serviceability of the cotton in the form in which it is used.

The shirts are numbered for identification and are worn in

rotation. All are being laundered throughout the wearing period by any one of the common methods of laundering. Records are being kept by each cooperator of the hours of wear and number of launderings, and of signs, locations or unusual circumstances of wear.

Laboratory tests include analyses of fibers, yarns and fabrics before wearing and after definite periods of wear.

Sets of the shirts are undergoing laundering but are not worn to determine if cottons differ in resistance to laundering, and to see how much of the wear is due to laundering and how much to the wearer.

Figure 56. Variations in height and weight of 3 of 55 persons cooperating in a study to determine the serviceability of garments made from cottons which differ as to variety, region where grown and the method of harvesting.

The wearers differ widely: in age, from 21 to 65; in weight, from 130 to 270 pounds; and in height, from $5\frac{1}{2}$ to $6\frac{1}{2}$ feet, Figure 56. In activity, they range from little or no strenuous exercise to manual labor. The effects of these personal differences will be included in the analysis of the serviceability of the shirts.

If differences in serviceability are found, the study will be directed toward the one or more factors which seem to have the greatest influence.

Two common varieties of cotton—Roldo Rowden and Rogers Acala—were grown in 1940 and 1941 at the Temple station in the Blackland Prairie and at the Lubbock station on the High Plains. The cotton was hand-picked at Temple and both hand-picked and snapped at Lubbock. The study had to be discontinued until after the close of the war.

The shirts were placed in service in December 1947. By August 1, 1949, 5 sets of shirts were considered by the wearers to be worn-out and were returned. These had undergone from 22 launderings with an average of 328 hours of wear per shirt to 38 launderings with an average of 462 hours of wear. One set which was laundered 28 times had been worn an average of 720 hours per shirt.

Figure 57. Part of a field day crowd at the Fruit Investigations Laboratory at Montague. Three groups can be seen at stops in the vineyard. Explanations of the purpose and progress of the experiments shown are being given by trained speakers at each stop.

Horticulture

FRUIT AND NUTS

Fruit Varieties

Peaches. The peach breeding program has resulted in the selection of 10 yellow and 2 white-fleshed freestones for mild winter adaptation. The most promising crosses are Halehaven x (Pallas x Hiley), July Gold x (Pallas x Hiley) and Early Elberta x (Pallas x Hiley). These selections have yet to be tested in commercial production areas but have shown up well under College Station conditions.

The first cross from Hiley x Pallas is the most promising for a combination of low cold with high heat requirement, Figure 58. In addition, it seems to carry a genetic factor or factors for bud hardiness. Seedlings from a backcross of this selection onto commercial varieties set full crops in 1943 and again in 1947 after 17° and 19° F., respectively, March 1 and 12, when the trees were in full bloom. There was no winter-killing of buds in the winter of 1948-49 when the temperature dropped to 3° F. below zero.

Berries. Three berry selections from Dewberry x Ness-

berry were released under the names of Earli-Ness, Big-Ness and Regal-Ness, Figure 59. These selections bear heavily, are strong

Figure 58. A promising first generation peach hybrid, resulting from a cross of Pallis x Hiley. This is a good peach, and is valuable also for further breeding work.

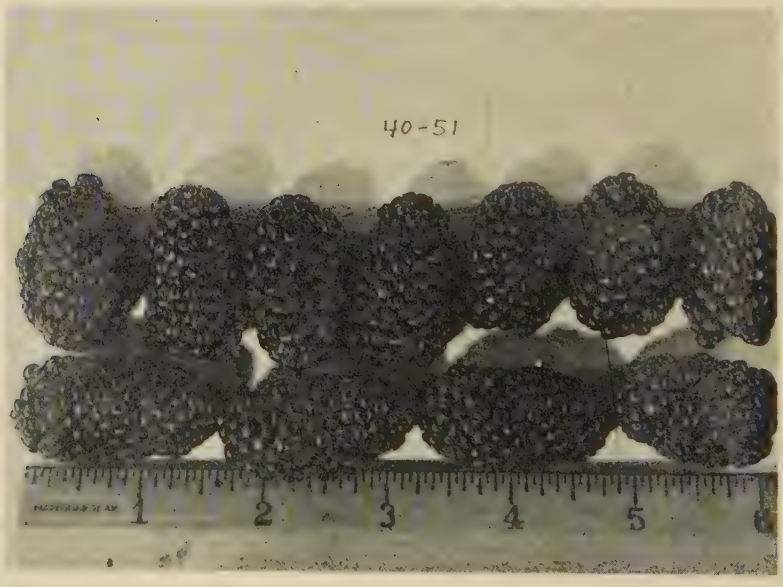

Figure 59. Regal-Ness berry, resulting from a backcross of Ness-berry on the wild Dewberry.

growers and are superior in many ways to the commercials tested against them. Their season is approximately May 1 to June 5.

Large second-generation populations from Lawton x Nessberry are being grown for selection of possible superior types. Filrst-generation seedlings are also growing from Nessberry x Young Dewberry.

Figs. One fig selection, Green Ischia x Hamma, has been chosen for its vigor, cold hardiness and productiveness. It is superior to many commercial varieties for fresh consumption as well as for freezing. Since it is a purple fig, no recommendations are being made for it beyond use as a home garden fruit. Over 55 varieties are now being established for testing and breeding work.

Strawberries. Breeding work has yielded a number of promising strawberry selections, one of which is being increased for release.

Grapes. Some outstanding grape varieties have been found for Texas conditions. Beacon is the most productive, with large, compact bunches of purplish-black berries. It has yielded over 5 tons per acre. Favorite is productive, like the Black Spanish in color and size of clusters, but with large berries of superior quality. Fredonia is the earliest of the promising selections. Clusters are compact and attractive with large berries of good eating qualities.

A cross of Edna x Blondin is a new, dark grape which is almost as productive as Beacon. The berries are irregular but the selection may be desirable for juice.

Other outstanding varieties for the home vineyard are Portland, Moore Diamond, Delaware, Ellen Scott and Last Rose.

Dates. A date variety test is to be started for the selection of varieties resistant to cracking under humid South Texas conditions, or for early-ripening varieties that can be harvested ahead of unfavorable weather conditions. Studies on quality, disease resistance and propagation will also be included.

Fruit Budwood Certification Program

Citrus. Widespread occurrence of psorosis, or scaly bark, as indicated by recent surveys, established the need for supervision and control of the sources of budwood. This virus disease is transmitted in propagation. Members of the staffs of the Department of Horticulture and Plant Physiology and Pathology have assisted in a survey of the extent of the infection in the Lower Rio Grande Valley, means of identification, formulation of a program for the production of a disease-free budwood, and in the establishment and supervision of a test nursery at the Weslaco station.

Peaches. Mosaic and phony peach are virus disease of peaches found in various parts of the State. Regular inspection and eradication projects removed many sources of infection, and whole areas have been completely cleaned. However, many orchards, including the fine variety collection at the Nacogdoches station, were wiped out. The diseases are spreading in many other orchards.

The Department has assisted in the development of a project for the ultimate production of budwood that can be certified as free from virus diseases. Peach seed were obtained from Kentucky, one of three states where no peach virus diseases have been reported, and a nursery was established near Tyler, in an area that was previously certified as free from mosaic and phony peach. Buds from peach trees of desirable varieties in disease-free areas will be budded on these trees. The resulting trees will be planted in permanent orchard for further observation and as a source of budwood.

Orchard Soil Management

Studies in cover crops and fertilizers for peach orchards are underway at the Stephenville and Tyler stations, and at the Montague laboratory. Several combinations of legumes and nonlegumes and several combinations of nitrogen, phosphorus and potassium were used at each location to determine the most effective combination for a peach orchard.

A similar study is being conducted with grapes at the Montague laboratory. Preliminary results show some favorable responses were obtained through the use of phosphoric acid, but sufficient information has not been developed to warrant definite conclusions.

A comprehensive fertilizer project on citrus was established in two locations in the Lower Rio Grande Valley on different soil types and with orchards of different ages. A third series is contemplated for another soil type. All orchards are of the same variety of grapefruit, and the amounts and ratios of nitrogen, phosphorus and potassium used for trees of a given age will be the same in each orchard. Rate of application will be increased each year on a definite schedule to compensate for the increased size of trees.

A preliminary 3-year study was conducted to determine root distribution, both vertical and lateral, of grapefruit trees of different ages and on soils of varying types. The information obtained was used in the establishment and in the design of the fertilizer trials.

Further soil management studies with citrus now underway involve a comparison of permanent sod with clean culture, and sprinkler and surface irrigation in combination with the soil management practices.

Figure 60. Recommended varieties of peaches, plums, apples and grapes attractively arranged for the benefit of visitors to the Fruit Investigations Laboratory at Montague. This laboratory has developed many production and cultural practices now used successfully in North Texas orchards and vineyards.

A comparison of clean culture and sod in a pecan orchard has been conducted for one year. Preliminary results indicate some definite responses from trees in sod over those clean-cultivated. Additional data must be obtained from several more years of work before any conclusions can be reached.

Propagation and Rootstocks

The Bruce plum is grown commercially in certain parts of the State. One of the handicaps of the industry is the relatively short life of the trees. There is some indication that this is associated with the methods of propagation and types of rootstocks commonly used. Comparative tests are underway by which the relative performance of the Bruce plum can be measured on its own roots and on rootstocks of peach, Marianna plum, Myrobalan plum, Mexican plum and American plum.

The Texas citrus rootstock project is being conducted at the Weslaco station. The problem is to find suitable rootstocks for the Lower Rio Grande Valley to replace the commonly-used sour orange rootstock in case of the occurrence of tristeza, a serious disease to which the sour orange rootstock is susceptible. The same series of rootstocks that are under test in Brazil for resistance to tristeza are also being used in several locations in the Valley in tests for tolerance to conditions of salinity and high concentrations of boron, as well as compatibility with the citrus varieties of commercial importance.

NUTS

Harvesting and Handling Equipment for Pecans

The Department is engaged in the study and design of equipment that will enable growers to expedite the harvesting and handling of pecans. Problems that arise in the use of mechanical shakers are being studied. These are: the size and length of cable to use, and their relationship to strength, ease of handling and "whipping" of the cable; the method of attaching the cable that is the most economical and the least injurious to the tree; and the length and speed of vibration most satisfactory for effectiveness.

The Department has constructed and is now improving a mechanical device for separating the pecans quickly from the leaves, husks and twigs which fall in the process of shaking pecans from the tree; and a mechanical huller which is designed to expedite the time-consuming task of removing the husks from the pecans by hand.

Pecan Breeding and Standardization

Attention is being given to the possible introduction of pecan varieties by planting pecans from trees that grow in locations where they will likely be pollinated by pollen from standard

varieties, and by planting seed that have developed from controlled pollination.

VEGETABLES

Cabbage

The cabbage breeding project is centered at College Station with extensive variety and fertilizer trials at the Weslaco station. The objectives are to develop a commercial variety having round, two to three-pound heads, uniform maturity, cold resistance and a high yield of dark green heads of high quality; and to determine the desirable cultural and fertilizer practices that will give a maximum yield of marketable heads.

Two strains have been selected at College Station for desirable head characters and cold resistance. These have not yet been tested in commercial areas due to insufficient seed, but they show remarkable resistance to cold and frost.

The fertilizer studies show that nitrogen, in particular, influences quality, size and marketability of cabbage. The tests indicate a need for research directed toward control of head size and market quality under conditions of high fertility. The desired cultural practice is to have a high-density stand that, under high levels of fertility, will produce a large yield of marketable heads. The Early Round Dutch variety is showing promise under these conditions.

Onions

Objectives of the onion breeding project are to develop commercial strains adapted to South Texas, and having resistance to pink root and thrips; to determine the best cultural methods for the El Paso Valley in the production of hybrid seed for commercial planting; and to develop improved strains of white onions comparable in uniformity, yield and season with Excel and Texas Early Grano. The Excel and Texas Early Grano varieties have been released and have had wide acceptance in the early spring market.

The project is continuing with material having resistance to thrips and pink root in yellow and white types, with the production of better white onions, and with the establishment of adapted male sterile lines.

A total of 256 selections were made from the 1947-48 material. Time of planting, seed to seed vs. bulb to seed, and varietal influences on yield and quality of seed are being studied. Additional work is contemplated on hybrid combinations, and eventually on the production of hybrid seed for commercial planting.

Southern Peas

The development of early, well-adapted, bunch-type, cream

varieties of Southern peas is being stressed. Early, high-yielding Cream and Purple Hull strains have been obtained from crosses involving Extra Early Blackeye, Long Pod Cream and Commercial Purple Hull. Plants have been selected for earliness, uniform maturity, high yield, long peduncles, and a bunch and runnerless type of growth, Figure 61.

Figure 61. Cream 14, a long-podded, early, productive, bunch-type pea bearing pods high above the foliage.

These strains are being tested in a state-wide trial to select the best one for release. Future attention will be directed toward incorporating disease and nematode resistance in the strains that show desirable horticultural characters.

Spinach

The development of spinach varieties with resistance to the major diseases in the Winter Garden area has been the objective of the spinach breeding project. These diseases are white rust, downy mildew and blight, or mosaic. White rust is the most important and will receive the greatest emphasis.

Successful procedures have been worked out for flowering spinach in the greenhouse under fluorescent lamps. Hybrids have been obtained and will be tested during 1949-50 under natural and artificial conditions of inoculation. Downy mildew resistance from certain California lines have been incorporated in some of the breeding lines.

Work is also being conducted on spinach material resistant to the cucumber mosaic virus disease.

Broccoli

Studies have been made on broccoli to produce well-adapted, high-quality varieties of early, uniform maturity with small-budded, non-leafy heads and shoots, and to produce types specifically adapted to definite uses, such as fresh-market or freezer types.

Texas 107 has been increased, but several years of bad weather resulted in insufficient seed for introduction. This is primarily a market type, although it has been selected for good side-shoot production.

Tomatoes

Studies are underway to develop a tomato with desirable horticultural characters and having resistance to Southern blight and Fusarium wilt. The objective at the Stephenville station is to develop a summer-bearing tomato. Summer Prolific was introduced by this station in 1947. This tomato will be crossed with other strains and varieties for size increase, wilt resistance and resistance to Southern blight. Similar studies are planned for the Winter Haven station. Stokesdale is the most satisfactory variety in this area but extension of the fruiting season, size increase and general productivity are needed characteristics.

Sweet Potatoes

The objectives of the sweet potato research project are to make available to growers in East Texas a variety of sweet potato having higher yield, more disease resistance and a more desirable inside color than the varieties now being grown. Shipping and eating qualities are considered of great importance. Approximately 34 breeding lines are being studied. A number of these are being used as breeding stocks, and others are being increased for field trials in 1950. Introductions thus far include Texas Porto Rico and Murff Bush Porto Rico. Constant roguing for several years produced a variety almost 100 percent bush.

Other Vegetables

Other variety adaptability studies and breeding projects have been started. Cantaloupes, sweet corn, cucumbers, lima beans and watermelons are under study in the several production areas over the State. A breeding project is planned at Prairie View in the hope of developing an adapted Black Diamond-type melon with resistance to anthracnose and Fusarium wilt.

FERTILIZER EXPERIMENTS

The effects of different rates and kinds of nutrient elements, alone and in combination, are being studied. Tomatoes grown in the fall under irrigation on Brennan fine sandy loam have responded to applications of nitrogen and phosphorus. Significant

increases resulted from these elements applied singly, but both nitrogen and phosphorus were required to produce the highest yields. The quality of tomatoes was improved by nitrogen fertilizer. These studies will be continued. Tomato fertilizer studies have also been conducted at the Robertson county laboratory, and plans have been made for similar studies at the Yoakum and Jacksonville laboratories.

The experimental design of all vegetable fertilizer experiments was standardized by using uniform increments of nitrogen, phosphorus and potassium in multiples of 20 pounds per acre, without regard to standard formulas. Further increase in uniformity was obtained through the use of one standard vegetable variety

Figure 62. Typical 8 by 60-foot cold frames showing sheets and garden hose for protecting and watering the plants. Tomato plants grow large stems, leaves and roots earlier, faster and safer in cold frames, such as these at the Tomato Investigations Laboratory at Jacksonville, than they do in the fields in early spring in East Texas.

in each set of trials. The design in each location was a complete factorial in randomized blocks, with four replications. Further comparisons were also made as to time of application of the various treatments in relation to the stage of development of the plants. Shipping and ripening trials were made on tomatoes from a whole series of 36 nutrient combinations.

Fertilizer studies on sweet potatoes have been conducted at the Gilmer laboratory. Potash appears to do more to increase yield and quality than either nitrogen or phosphorus.

Studies were made on watermelons during 1949 at Prairie View to determine the effect of varying amounts of nitrogen, phosphorus and potassium on yield of marketable melons, and to establish a measurement of quality in melons produced under varying nutritive conditions.

FRUIT AND VEGETABLE PROCESSING LABORATORY

Preliminary investigation on a method of sampling broccoli to determine its quality for freezing preservation was started in 1947. Analyses indicate considerable variation in the amount of ascorbic acid among the different parts of the head of broccoli. Stems of the flowers midway between the upper and lower flowers averaged the lowest ascorbic acid content.

Freezing of .5, .75 and 1.00 percent gelatin in 20 percent dextrose solutions, adjusted to 5.55 and 3.41 active acidity, resulted in the formation of softer crystals than when no gelatin was used. These mixtures were frozen and held at 0° F. for 40 days. With the same amounts of gum arabic and 150 grade pectin, the crystal formation was hard and the mixture had a tendency to separate on freezing.

Storage tests at 45 and 80° F. of ascorbic acid added to various sugar solutions and mixtures up to concentrations of 50 percent indicated that sucrose was more effective in protecting the ascorbic acid at any given concentration than commercial dextrose (Cerelose) and Sweetose.

Fairs Beauty, Elberta, Augberta and Barbara freestone peaches were frozen at —20° F. in 50, 30 and 20 percent (by weight) syrup solutions of dextrose, Sweetose and sucrose, with 25 milligrams per 100 grams of ascorbic acid added to half the samples. The additions of ascorbic acid resulted in marked improvement in appearance, but not in texture or flavor. All varieties of peaches frozen in 30 percent Sweetose were firmer than those frozen in other concentrations of syrups.

The adaptability to freezing of Big-Ness, Earli-Ness and Regal-Ness berries was compared with that of several commercial varieties. Each variety was washed, placed in 300R enamel cans, covered with a 50 percent sugar syrup, cooled to 45° F., then frozen at —20° F. They were removed from storage

at 3-months' intervals and judged on the basis of appearance, consistency and flavor. All three new berry selections were judged superior to Lawton, Early Wonder and Youngberry.

Three new fig varieties were lye-peeled and frozen in a 30 percent syrup at —20° F. Two selections were the result of a cross of Green Ischia x Hamma, the other was an unknown variety. All made excellent frozen products and were considered superior to Celestial or Brown Turkey.

Ten new strawberry selections were frozen in a 4-1 sugar pack at —20° F. and compared with the Blakemore and Klondike varieties. The selections T-72 and T-88 were equally as good as the comparative varieties, but lacked the deep red color.

Grape varieties and selections obtained from the Montague laboratory were tested for juice manufacture for several years. Only 3 of the 50 or more varieties and blends of varieties handled show much promise. The Fredonia, Beacon and Favorite varieties produce fairly good juices, but none compares favorably with commercial juices now on the market.

New canning research was initiated in 1948-49. Certain studies deal with the retention of nutritive and quality constituents of citrus and tomato products as affected by storage conditions. Canned grapefruit, orange juice, grapefruit juice and grapefruit-orange juice combinations of known pre-processing history were placed in storage rooms with constant temperature. These chambers are maintained at 34, 70 and 110° F. The products are examined every 3 months for such factors as the retention of certain vitamins, color and market grade. Taste tests also give an index to the acceptability of the product. One of the most noticeable effects of storage temperature is that of color retention. Color plays an important role in the market grade of citrus products. Improper storage temperatures influence the retention of color, ascorbic acid and general acceptability.

Canning research with Purple Hull and Blackeye peas was started during 1949. The production of canned peas of this type is assuming major importance in Texas. A survey of operational procedures revealed that different processes are employed by the various pea packers of the State, and the result is a divergent quality of product. Work was started to determine the effect of pre-processing and in-plant handling procedures on the quality of these peas. Fundamental studies are also underway in an attempt to isolate, identify and to render inactive any compound which causes discoloration in canned peas. Other studies on this group of peas were in connection with ascorbic acid and the vitamin B complex.

The Food Processing Laboratory is also testing the effects of cultural treatments on the quality of certain crops. Watermelons from the fertilizer trials at Prairie View were tested

by a group of judges in the laboratory in 1949. The Weslaco station has on test Rutgers tomatoes grown under 36 different fertilizer levels. The laboratory packed 62 cases of tomatoes from these experimental plots, and is now analyzing the product to determine the influence of the fertilizer treatment on canning quality. The laboratory cooperates with the Weslaco station in an attempt to find a better canning tomato. This work, begun in 1949, is a screen test of existing tomatoes varieties for cultural and canning qualities.

Selections from the berry-breeding project at the Main Station were canned to determine their adaptability as a canning product. Selections from the Southern pea-breeding program were canned to determine their processing qualities. The testing of the existing varieties and selections from the breeding projects is an essential part of the activities of the Food Processing Laboratory.

The laboratory is frequently called upon to assist processors of a variety of products in the State. It assisted during 1949 in a lemon juice clarification problem, formulated a process for frozen Meyer lemon pie mix, produced a straight-line pickled peach process, and started one packer in the production of Maraschino cherries. Other activities have been with berry packers in an effort to improve the sanitary practices in berry plants, with packers in North Texas on equipment modifications as influencing quality of product, with packers in the Jacksonville area on formulation of fruit preserves and jellies, and in participation in grower-canner conferences.

Several canner conferences were held during 1949. Contacts with the canners at such meetings and at the meetings of the canning industry have strengthened the relationship between the Station and the industry.

Plant Physiology and Pathology

PLANT PHYSIOLOGY

Effects of 2,4-D on Cotton

Considerable damage was done to cotton and other susceptible plants near rice and flax fields or brushy areas that were dusted by airplane with 2,4-D weed killer in 1947. The Station conducted studies in the Gulf Coast area throughout the summer on the damage by 2,4-D to cotton, particularly as to persistence of the effects of the chemical and the recovery of the cotton plants. Many of the fields affected were several miles (up to about 15 miles in one case) from the rice fields dusted with 2,4-D.

Although serious crop effects were noted, the concentration of the weed killer apparently was not sufficient to kill any of the cotton plants in the fields under observation. Figure 63 shows the effects of the 2,4-D that drifted onto cotton and some of the unexpected results.

Greenhouse experiments have shown that one ounce of 2,4-D could cause measurable yield damage to 35 acres of cotton, if the chemical was equally distributed over all the plants.

Tissue Tests to Determine Fertilizer Deficiencies

A study of tissue-testing methods was made with the hope that a system could be developed for cotton which would help to determine fertilizer deficiencies. Such procedures are used on corn and some truck crops.

The first phase of this project was to determine which part of the cotton plant would be best suited for testing. It was found that the concentration of nutrient elements in the petioles reflects better than any other part the nutrient status of the entire plant.

The second phase was on the relation between the concentrations of the soluble nutrients in the petiole and their level of supply in the soil on one hand, and with growth on the other.

In greenhouse and field studies, the concentrations of nitrogen, phosphorus, potassium, calcium and magnesium in the leaf stalk were found to be directly related to their level of supply in the growth medium. It has been observed on cotton, as has been reported on other crops, that a limiting supply of one element may cause an accumulation of a second element in the petiole. Such interactions were noticed between nitrogen and phosphorus and also between potassium and magnesium, and there are indications others may exist.

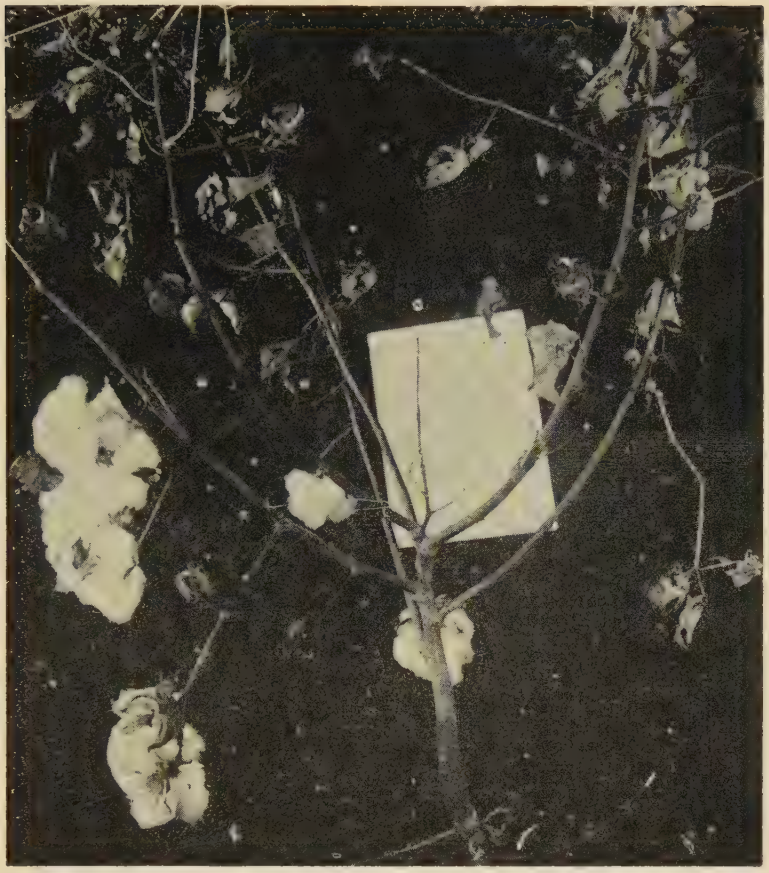

Figure 63. Typical recovery of a cotton plant from 2,4-D damage. Healthy lateral branches from the lower stem, with normal leaves and bolls, occurred generally under favorable growing conditions. The original top of the stem (against white background) ceased to grow and often died from the effects of 2,4-D.

These relations between nutrient elements are of basic importance in the proper evaluation of tissue-test results. Further work is necessary on that phase of the problem.

PLANT DISEASE CONTROL

Dying of Live Oaks

The sporadic dying of live oaks in some Central Texas areas has caused concern to homeowners, farmers and ranchmen for several years. Large oak trees have been observed to die suddenly, regardless of the season or the nature of the site, Figure 64. Young trees also are affected and an entire clump of

Figure 64. Live oak trees in a Bosque county farmyard died suddenly in 1940 from the so-called live-oak disease.

small trees (mott) may die within a year or two. Often a tree that was apparently healthy at the time of normal leaf shed in the early spring will fail to come into leaf at the usual time and soon may be dead.

No organism has yet been found as the cause of the trouble. The symptoms suggest some sort of a plant disease—possibly of a virus nature.

Experiments in Bosque county indicate that early pruning at the first appearance of the trouble may save the tree. The pruning, apparently, must be severe to be effective and it should be done when the foliage first shows signs of fading color.

Late Blight of Potatoes

A striking demonstration of the control of late blight in potatoes was made at the Weslaco station in a season when this disease was generally destructive. The blight fungus was already active in the field when the test was started. Best results were obtained with the organic fungicide Dithane applied as a spray in four applications at 5 to 8-day intervals, Figure 65.

The yield following this treatment was 242 bushels per acre, compared with 109 bushels in the non-treated check plots. Yellow copper oxide (cuprocide) at 1½ pounds per 100 gallons as a spray and as a 5 percent dust, showed good results, with yields of 213 and 217 bushels, respectively. All applications were by hand.

Figure 65. The main part of this field of potatoes and non-treated plots were completely killed by late blight. Left plot (2 rows) sprayed with Dithane; right, sprayed with cuprocide; center, dusted with one of the earlier trial organic fungicidal dusts which gave only partial control. The light areas (healthy foliage) in the picture were green in the field. These areas contrasted sharply with the brown, diseased plants (background).

The best treatments contrasted sharply with the non-sprayed areas and showed the benefit that can be obtained from fungicidal sprays when the applications are timely and thorough.

Helminthosporium Blight of Oats

Helminthosporium blight (also called Victoria blight and root rot of oats) has in recent years become a destructive disease of oats in the humid sections of Texas, Figure 66. The disease attacks the plants throughout their life, causing reduced stands, lodging of plants, reduced yields and light grain.

Some reduction in the severity of the disease can be obtained by crop rotation and seed treatment.

The crown (leaf) rust-resistant varieties distributed in 1939 —Fultex, Ranger and Rustler—are highly susceptible to Helminthosporium blight and the acreage planted to these varieties has shown a rapid decline in recent years.

The Red Rustproof varieties, such as New Nortex, are highly resistant, as are the varieties Camellia and Alber, which are suitable for growing in South Texas.

Figure 66. Normal roots of oats at right and Helminthosporium blight-infected roots at left. Notice the almost complete destruction of roots by the disease.

Breeding work to develop new varieties resistant to Helminthosporium blight and other diseases constitutes an important phase of the oat improvement program. New strains resistant to Helminthosporium and rust have been selected and are now being tested for adaptation.

Protective Seed Treatments for Rice

Seed of Bluebonnet and Rexoro rice were treated with Spergon, Cuprocide, Arasan, Dow 9B and Ceresan M at the Beaumont station in 1948 and 1949. The materials were used at the rate of 1 ounce per bushel, except Ceresan M, which was at one-half ounce per bushel.

Emergence from May seedings was better than from June seedings during both years and, except for an indication of injury to Rexoro by Dow 9B in 1949, there were no significant differences among treatments. No injury to the seed was caused by storage for 4 to 5 months after the fungicides were applied to the seed, and all the fungicides gave adequate protection.

These fungicides are available for use in the slurry form, which minimizes the discomfort to the operator at the time of application.

Citrus Scaly-bark Prevention

Prevention of virus diseases of citrus trees, especially of the disastrous psorosis or scaly-bark disease, is being studied in the Lower Rio Grande Valley, Figure 67. This involves the establishment of a test-plot nursery at the Weslaco station and

Figure 67. This trunk of a large grapefruit tree was severely damaged by scaly bark. In addition to the scaly bark entirely encircling the two main branches, notice the discolored regions within the cut branches and roots which were made almost functionless by the disease.

periodic inspections of selected prospective budwood source trees for the obscure leaf symptoms of the disease and for bark symptoms. Buds from each tree undergoing test for reliability are inserted into nursery seedlings in the test plot and are observed throughout the next year for possible appearance of leaf symptoms that would indicate transmission of the virus. Only budwood source trees that pass both the orchard inspection and the test-plot nursery phases are designated as reliable budwood source parent trees.

When such trees are declared healthy by the State inspector, they may be registered and the budwood used for the increase of virus-free propagating materials and for the propagation of nursery stock to be sold as registered stock. Inspection and roguing of nursery trees and of newly-planted young trees are also included in the project.

Disease-resistant Strains and Varieties

Blight-resistant cotton. Breeding of cotton resistant to bacterial blight (sometimes called angular leaf spot, black arm or bacterial boll rot) is being done at the Main Station and at several of the substations.

Resistance to blight has been incorporated into a number of varieties of cotton commonly grown in Texas by crossing these

Figure 68. Bacterial blight lesions on the bracts and bolls of susceptible plants (upper row) and on resistant plants (lower). Notice the water-soaked, blackened lesions on the susceptible material and the very localized lesions on bracts from resistant plants. The latter lesions seldom give off enough bacteria for further spread of the disease.

Figure 69. A nematode-resistant strain of tomato on the right. A susceptible variety showing many root knots on the left.

varieties with a blight resistant line (Stoneville 20), backcrossing the hybrids to the locally-adapted varieties, and selecting for type and resistance. The resulting progenies are almost free of symptoms of bacterial blight on the leaves, bracts and bolls, Figure 68. Although the bacteria may be found in the tissues of resistant plants, apparently they are unable to make complete utilization of the cell contents and, thus, are restricted in the extent of tissue damaged. As many of the fungi associated with boll rotting commonly gain entrance to the boll through blight lesions, the development of blight-resistant lines should reduce the losses caused by these secondary organisms.

Blight-resistant lines have been established in crosses with the Stoneville 2B, DPL, Empire Wilt, Rowden and Acala varieties of cotton. The agronomic value of these lines will be tested further before being released for distribution.

Tomatoes resistant to the root-knot nematode. Significant progress is being made in transferring the root-knot resistance of a wild South American tomato to strains of the cultivated tomato. Some difficulty was experienced in getting fertile hybrids, but strains have now been developed that are highly self and cross-fertile, have a high degree of resistance to root-knot and bear fruits 1 to $1\frac{1}{2}$ inches in diameter. The degree of resistance that some of these hybrids have is shown in Figure 69.

Figure 70. Weslaco Strain C, downy mildew-resistant cantaloupe held 3 days after harvest at 85 to 95° F. The flesh is bright apricot in color, with a narrow green border beneath the rind.

These susceptible and resistant plants were grown side by side and had an equal chance to become infected with the root-knot nematode.

Downy-mildew resistant cantaloupe. The development of a downy mildew resistant strain of cantaloupe has continued for several years at the Weslaco station. Several strains were grown in the spring of 1949 without serious disease infection, while commercial varieties were badly affected. One strain, designated tentatively as Strain C, a selection from a (Smell Melon X Hales Best) x Smith Perfect combination, was selected for a field-performance and shipping-quality test, and for seed increase in the fall of 1949.

Weslaco Strain C cantaloupe is an advanced strain that looks promising, Figure 70. Its principal advantage over other varieties grown in the Lower Rio Grande Valley is its resistance to downy mildew. The yield and uniformity of fruit have been satisfactory. The fruit is firm and is expected to stand up well in common and cold storage, and in transit. Since the strain has demonstrated tolerance to downy mildew, cantaloupe growers and agricultural workers in the Valley recommended that it be released. If it continues to do well during the process of foundation seed stock increase, the strain will be available for limited commercial planting in the spring of 1950.

Figure 71. Five dressed pullets of the reconstituted Cornish-Hampshire line.

Poultry Husbandry

Texas chicken and turkey flocks are small in comparison with those of other states ranking near it in total poultry numbers. This results in many problems not found in states where the industry is made up largely of commercial size units. The adoption of newer practices and improved methods is slower when the poultry enterprise accounts for a very small proportion of the total agricultural income of a farm.

THE NEW POULTRY HUSBANDRY SET-UP

Reorganization of research, teaching and extension in the Texas A&M College System necessitated the bringing together of the various research and instructional physical plants. The Poultry Husbandry Department was assigned approximately 40 acres for permanent building sites and 101 acres for a 3-year rotation of chicken and turkey ranges for growing replacement stock.

The new buildings are large and of uniform design so that experimental replications will be easy, and labor requirements may be kept at a minimum.

The new farm layout calls for a central building 50 by 120 feet; a battery brooder house 40 by 120 feet; two chicken brooder houses 24 by 192 feet; two laying houses 30 by 192

feet; two breeder houses 24 by 162 feet; two trap houses 24 by 212 feet; one turkey breeder house 30 by 160 feet; two turkey brooder houses 30 by 80 feet; and miscellaneous service and utility houses.

The designs and sizes of the poultry houses could be used on Texas commercial poultry farms. Special adaptations will fit them for use in experimental, instructional and extension projects. Building materials are fireproof, easily sanitized and have a low maintentance cost.

CHICKENS

Breeding and Flock Improvement

Meat type. Rapid increase in egg production per hen, increase in consumption of poultry meat and more efficient production practices, combined to place greater emphasis on a commercial broiler program, which in turn, has brought about a widespread demand for a better meat-type chicken.

Two comparative tests, involving more than 2,000 birds, were made to determine the relative merits of several of the more promising breeds and crosses under Texas conditions. Gains, feathering, livability, feed efficiency and market grades were determined on New Hampshires, White Rocks, Barred Rocks, Hampshire x Leghorn, Rock x Hampshire, and Indian River crosses. New Hampshires hatched well, grew fast, feathered fast, lived well and had good dressing and market qualities. In every comparison made, the Barred Rock x New Hampshire cross gave slightly faster gains and slightly lower mortality than the straight New Hampshires, but the feathering of the crossbreds was not as good and the dressing qualities were inferior because of the black feathers and hairs.

An effort is being made to produce a new chicken with superior meat type. The Cornish breed has excellent meat type but its growth, feathering and reproductive qualities are generally poor. The Cornish has been crossed with New Hampshires, White Rocks and Leghorns. Backcross selections were made to fix the desirable market type and the other characters necessary in a good meat-type bird. The Station has a number of pens that look rather promising for crossing with the straight New Hampshire to produce a good broiler. Figure 71 is of a group of dressed pullets from one of these pens. They show excellent fleshing and width of breast.

Inbred lines. Production of sufficient numbers of superior inbred lines for hybrid combinations is an expensive procedure and outside the limits of the average poultry breeder. A number of states were organized on a regional basis for the production and testing of these lines. The Texas Station now has a number of lines with more than 50 percent inbreeding and a

number of other lines approaching this percentage. These inbred lines will be tried in various combinations within our own lines and with lines from other stations. Testing of these combinations will be done at a central testing station located at Purdue University.

Blood antigens. A number of blood groups were discovered in chickens and turkeys. In the production of inbred lines, it has been common experience to find certain individuals with outstanding excellence. Blood antigen studies offer an opportunity to determine whether these individuals represent a superior combination of desirable genes. Since early work with the blood antigens revealed heterozygosity even in the highly inbred lines, there is the possibility that heterozygosity may have some selective value. If this proves to be the case, we may have some basic information on the desirability of heterozygosity for the maximum expression of hybrid vigor. Search is being continued genetically for a sex-linked blood antigen; if it is found, we shall have a means of positively identifying sex at hatching.

Hormones in poultry production. A number of state stations and commercial research laboratories have conducted experiments to determine ways in which synthetic hormones or hormone-like substances may be used economically by the commercial poultry and egg producer. The Texas Station has been trying several of these substances in various combinations.

The substances tried include: protamone (a synthetic material having thyroid activity), which promotes faster feathering and perhaps faster early body growth; thiouracil (a synthetic material having anti-thyroid activity) which slows down the rate of living and results in better fattening qualities; and estrogen (female sex hormones, some of which are produced synthetically), which encourage fattening and in some instances faster gains.

Feeding 10 grams of protamone per 100 pounds of feed for the first six weeks and following with a combination of 0.2 percent thiouracil and 0.0067 percent estrogen for 4 weeks, resulted in fryers as large or larger than the controls and of exceptionally high quality, Figure 72. Such birds are unusually fat and very soft-meated. Only about half the usual time is required for frying and the dressing loss is usually decreased from 3 to 5 percent.

Some workers have felt that these hormones are useful in treating surplus cockerels and old breeding males after they are removed from the breeding pens. Experiments conducted by the Department showed that surplus cockerels fed 6 weeks on a combination of 0.2 percent thiouracil and 0.0067 percent dienestrol diacetate resulted in gains almost twice that of the controls, 4 percent decrease in dressing loss and carcasses of exceptionally good quality.

Figure 72. The No. 11 group was fed the basal ration only from 1 to 12 weeks; the No. 7 group was fed the basal ration and protamone for the first 6 weeks, then the basal ration, 0.2 percent thiouracil and 0.0067 percent estrogen for 6 to 12 weeks.

Nutrition and Feeding

Research on poultry nutrition has been particularly active and productive the past few years. Two of the most active fields have been the discovery and production of practical sources of new factors required for best poultry nutrition, the reduction in the crude fiber and stepping up of the productive energy levels of poultry rations.

New APF (B_{12}) concentrates for growth. Tests were conducted with a ration composed of soybean oil meal, corn and/or milo with mineral and vitamin supplements and supplemented with two sources of the animal protein factor (APF). When only the basal ration was fed, the birds weighed $1\frac{1}{4}$ to $1\frac{1}{2}$ pounds at 10 weeks. When it was supplemented with the animal protein factor concentrate or vitamin B_{12}, weight was increased to $2\frac{1}{4}$ pounds at 10 weeks. This growth was somewhat better than that of birds fed a ration made up of soybean oil meal, fish meal, and meat and bone scraps as a source of protein. These tests were repeated in batteries five to six times with the same results.

These tests were also conducted at the Gonzales station. They left little question of the feeding value of such APF concentrates in the rations for growing chicks.

In further tests conducted at College Station with cottonseed meal as the source of protein, the response to APF and fish solubles was not as good as when soybean meal was the chief cource of protein. The cottonseed meal ration was low in lysine.

The amounts of the animal protein factor concentrate used in these experiments contain more vitamin B_{12} than is necessary and supports the theory that other unknown factors are present in the APF concentrate. It is felt that these findings are particularly important with the growing shortages of the animal protein concentrates, such as fish meal, and meat and bone scraps.

Vitamin B_{12} for egg production. Research by the Department shows the importance of vitamin B_{12} in the ration for egg production and hatchability. Without this factor, hatchability decreases to zero in about 2 weeks. A deficiency of vitamin B_{12} also decreased egg production.

A particular abnormality was noted in the embryo from eggs laid by hens fed a ration deficient in vitamin B_{12}. The muscles in the leg failed to develop. Approximately 50 percent of the embryos in eggs from hens fed a vitamin B_{12} deficient diet died at about 17 days of incubation.

Pteroyglutamic acid requirements of the laying hen. A purified type of diet was used in these studies. It was made up of

casein and sucrose and properly supplemented with minerals and other vitamins, with the exception of PGA. Such a diet limits the intake of a particular vitamin under study, folic acid in this case. It was found that the laying hen requires approximately one milligram of folic acid per kilogram of diet, or about 5/19 milligram per pound of feed, to maintain the highest level of hatchability, and particularly to allow an adequate carry-over of this vitamin from the hen through the egg to the chick.

With an inadequate level of folic acid in the hen's ration, the level of folic acid in the eggs was decreased. Although hatchability was not decreased appreciably, the livability of the chicks was decreased. This indicated that a carry-over of folic acid is necessary for the early development of the young chick. Chicks hatched from hens on a particularly low level of folic acid had a reddish skin and the peak of embryonic mortality was during the last 3 to 4 days of incubation.

Hens on a practical type of ration were studied along with these birds. An ordinary practical all-mash type of laying ration supplied an adequate level of folic acid in the eggs and, likewise, an adequate carry-over to the newly-hatched chick.

Synthesis of vitamins by bacteria in the intestinal tract. Materials were taken directly from the gastro-intestinal tract of turkeys and chickens and analyzed for riboflavin, folic acid, biotin, nicotinic acid and pantothenic acid. Significant quantities of these vitamins were found in the intestinal matter. The concentration of the vitamins was higher in matter taken from the cecum than from other portions of the tracts.

Upon completion of this work, the ceca were removed from the birds. It was determined that this portion of the digestive tract would not appear to function as the site of vitamin synthesis by bacteria, since the vitamin content of the intestinal matter from cecectomized birds was not decreased below that of normals when a practical ration was fed. On the other hand, the biotin synthesis of the cecectomized hens was increased by removing the cecum.

This indicates that one of the reasons for the higher vitamin content in the cecal material from a normal hen is possibly due to the longer holding period for fecal matter in this part of the tract. The results also indicate that actually the vitamins may be absorbed by nonsynthesizing organisms in the tract, such as yeast, and not be available to the host animal. Yet, it could be detected by vitamin determination in the cecal matter tests.

Sorghum gluten meal in poultry rations. A number of tests were made to determine to what extent and how milo gluten meal, a by-product in the making of starch from grain sorghum,

may best be used in poultry rations. If milo gluten meal is used in growing rations at 10 percent or higher levels, it should be supplemented with protein sources high in certain amino acids known to be low in the milo gluten meal.

Much additional work needs to be done before final evaluation can be made of this by-product for use in poultry rations.

High efficiency rations for laying hens. Laying rations high in productive energy and low in fiber were compared with the regular type laying ration in use for many years. The high efficiency rations produced about 18 percent more eggs on about 5 percent less feed and resulted in birds about 14 percent heavier than those on the regular ration.

A repetition of these trials is in progress. The comparison is even more favorable for the high efficiency ration at the end of the first 6 months.

Sanitation, Disease and Parasite Control

Coccidiosis. One of the most prevalent diseases causing losses to poultrymen is coccidiosis. A number of methods were tried to control the disease. We have found that keeping birds on wire floors will reduce, if not eliminate, losses from coccidiosis, but this often results in poor feathering, increased number of breast blisters and poorer market grades.

Birds fed sulfaquinoxaline at the 0.0125 percent level showed a 30 percent reduction in mortality and a 10 percent increase in gain over the controls receiving no medication. Birds receiving a commercial borax-urea compound showed higher death losses and poorer gains than the controls.

Lice and mite control. Some work was done on the use of various BHC (benzene hexachloride) compounds and the gamma isomer lindane on the control of poultry lice and mites.

Effective control was obtained by the use of a spray containing a mixture of 1 percent lindane and 2 percent DDT. This mixture can be applied as a roost paint shortly before the birds go to roost at night, or it may be sprayed on the roosts, nests, litter and on and around the birds.

Disinfection of hatching eggs. Either liquor cresolis or one of several of the quaternary ammonium compounds gave good disinfecting results and increased hatchability slightly, especially if the eggs were dirty when dipped in the disinfectant.

Pullorum disease. Some preliminary tests were made to determine if the variant types of pullorum commonly found in Canada and the Northern States, are present in Texas. No positive proof of the presence of these types was found but, with the large number of chicks and hatching eggs shipped into the State, it probably will be only a short time until they are found.

Internal parasite control. The internal parasite problem becomes acute if the birds are permitted to range on the same yards year after year, particularly in warm, humid climates. Frequent worming of the birds is required, which results in a drop in egg production. Birds in the Department's laying flock have been kept in total confinement in the laying houses since 1948. This lowered the internal parasite population, and worming is no longer necessary.

Management Practices

Floor space. Tests at College Station and the Gonzales station showed that best growth, feathering and livability of broilers were obtained when approximately two-thirds to three-quarters of a square foot of floor space per bird was provided.

Wire floors versus sand litter. Broilers grown on wire floors showed lower mortality and slightly better gains than birds on sand litter. In most tests, however, birds reared on wire floors showed poorer feathering, more breast blisters and lower market grades than those raised on litter.

Battery versus floor brooding. Birds reared in batteries showed lower mortality and greater gains than those reared on dirt floors and cane litter. Battery-reared birds, however, showed poorer feathering, greater number of breast blisters and a greater tendency toward feather picking and cannibalism than those reared on litter.

Grit in growing rations. No advantage was found in feeding granite grit in a comparison involving 16 lots of birds fed rations varying from 2.16 to 7.47 percent fiber. Four different rations were compared. For each ration, two lots got the basal ration and two received a supplement of 1 percent granite grit.

Processing and Marketing

Effect of dressing and storage methods. Poultry loses in appearance and flavor if kept in frozen food lockers for extended periods. Keeping quality during storage is also influenced by method of dressing and packaging. Experiments are underway to determine better methods of processing, packaging and storing dressed fryers and broilers.

Effect of Newcastle disease on eggs in storage. A study of the effects of Newcastle disease on the quality of market eggs, both fresh and after storage, showed that both the albumen and shell quality are affected. The eggs grade lower and greater storage losses occur in eggs from Newcastle-infected hens.

Community nests. Considerable interest has developed in recent years in the use of large community nests for laying hens. Some of the claims made for this type of nest are that they are more economical to construct, there are fewer broken eggs, and fewer dirty eggs, and eggs are gathered faster.

Comparisons are in progress at the poultry farm to determine if these claims can be substantiated under Texas conditions.

TURKEYS

Nutrition and Feeding

Effect of lysine on turkey plumage. Rations low in the amino acid, lysine, cause Texas Broadbreasted Bronze turkeys to show plumage of poor quality and white feathers. The rate of feather growth was also slowed down by these rations. An increase in the amount of animal protein in the turkey ration, or avoiding excessive grain feeding will prevent this condition. Figure 42 shows a typical example of this abnormal feather condition.

Nutritive requirements of hens. Very little is known about the nutritive requirements of the Broadbreasted Bronze turkey hen. Most of our estimates are based on studies obtained with the chicken. The Department has developed a type of laying cage that can be used for the study of the nutritive requirements for production and good hatchability. This work has shown the inadequacy of present recommendations.

Attempts to determine if the turkey hen requires vitamin B_{12} for maximum production and hatchability are as yet inconclusive. In tests with growing turkeys, a ration made up of soybean oil meal and corn apparently did not need to be supplemented with any source of animal protein. These results are in line with those obtained by other laboratories over the country.

Breeding and Physiology

Effect of size and type. Two lines of turkeys were selected on the basis of size, width of breast and market type. The so-called meat type, selected for greater size and width of breast, was lower in fertility, hatchability and egg production than another line not so extreme in market type. Whether this means that, for maximum fertility, hatchability and egg production, Broadbreasted Bronze breeders must select for a less extreme type has not been shown, but may be suggested.

Semen examination and artificial insemination. Breeders often find Broadbreasted Bronze toms that consistently give low fertility. Ability to evaluate the potential fertility of a tom before he is placed in the breeding pen would be of great value to the breeder. Since good fertility persists in turkeys for 3 to 4 weeks from a single mating or insemination, it is possible that artificial insemination late in the breeding season would aid the breeder in maintaining high fertility to the end of the season.

Tests were conducted on four Broadbreasted Bronze toms to determine if semen examination would be of value in predicting

fertility in natural matings, and for the feasibility of artificial insemination for increasing fertility. These tests showed that: toms vary in the density of their sperm count; the creamier the color of the semen sample, the denser the sperms; the quantity of semen per collection ranged from 0.5 to 2 cubic centimeters; 12 to 13 percent abnormal sperms were noted from all toms; the highest fertility attained by artificial insemination was 87.5 percent; hens having low fertility by natural matings had their fertility increased by artificial insemination; and fertility persisted 25 days after removal of toms in 50 percent of the hens.

Marketing as affected by variety and sex. Advent of the large Broadbreasted Bronze turkey introduced a new problem in marketing. When turkeys are plentiful, considerable differences in price develop between large and small type turkeys. The large Bronze tom is ideal for institutional use but is too big for normal family use. For this reason, a considerable difference in price has developed between toms and hens, although a higher percentage of the total weight of the male is edible meat.

Comparison of the cost of production of the large Bronze and the Beltsville Small White turkey showed that the large birds could be produced more economically in Texas. Only when a considerable difference in price range exists would it be profitable for Texas producers to raise the small birds.

Housing and Management

Combination brooder house and range shelter. Texas has a wide range of conditions to be met in the construction of poultry houses. A flexible type of house, offering a tight interior in the cold months of brooding and an open structure during the hot weather of the growing period, is needed from both an economical and a sanitary management standpoint.

Figure 73 shows a combination house that has proved successful at the Department poultry farm. It should be well adapted for the turkey producer wishing to brood about 100 poults.

Price-quality Relationships

The price differential on Texas turkeys has been unfavorable to the producers for many years. Whether climatic factors, production practices or poor quality stock is responsible for these differentials remains to be determined. A project is underway to attempt to evaluate the causes responsible. This work has not progressed far enough for any conclusions to be drawn.

Turkey Steaks

In attempting to increase consumption of turkey meat and encourage its use the year-round, methods have been worked out for producing a boneless turkey steak. This new meat delicacy is now being served in a number of restaurants and hotels over the State.

Figure 73. Top—the turkey combination brooder and range shelter enclosed for brooding. Bottom—the shelter open for use on the range.

Publications and Information

Publications by the Station during the 3 years covered by this report included 31 bulletins, 11 circulars, 40 miscellaneous publications, 158 progress reports, 275 articles in technical journals and 118 articles in farm and ranch magazines.

In addition, progress in agricultural research was reported in a large number of newspaper releases from the Main Station and the various field units. Staff members appeared on many programs for technical workers and for farmers and ranchmen. They assisted with many short courses, and discussed their work over the radio, in interviews and by personal correspondence. Many staff members are officers or directors of organizations in their respective fields.

Field days were held during 1947-49 for general and specific groups at many of the field units, with attendance up to 3,000 persons in some instances, Figures 57, 74 and 75.

Research bulletins, circulars, progress reports and some of the miscellaneous publications are sent as issued to co-workers in other institutions and agencies. They also are sent free

Figure 74. A group of farmers touring the Blackland station at Temple. Experimental results are broadcast over a loudspeaker system mounted on a truck. This station has about 8,000 visitors each year.

in limited numbers upon request by individual farmers, ranchmen and students. An annual circular, available free upon request, lists the publications that can be obtained from the Station. Also listed are the technical articles published the preceding year, reprints of which may be obtained from the authors.

The Publications Office, during this 3-year period, filled 20,385 individual mail requests for 84,288 publications; gave 48,215 publications to personal callers, and sent 274,861 publications to selected lists.

Figure 75. Explanation of pasture experiments underway is being made to a group of West Texas ranchmen during a tour over the Sonora station.

Range Management

THE BRUSH PROBLEM

The infestation of noxious brush species on fully 70 percent of the range lands of the State constitutes a problem of major importance in the management of these lands. The encroachment of mesquite, prickly pear, whitebrush, live oak, shinnery oak, cedar, blackbrush and other species has substantially reduced the amount of desirable forage, Figure 76. It has made difficult the management of livestock ranging these lands and increased the hazards of screwworm infection and diseases.

The extreme depletion of the forage cover over much of the range area and the rapid invasion of these noxious brush species into the remaining productive lands emphasizes the critical need for a three-fold attack on the problem. This involves the reduction of competition from brush species by suitable mechanical, chemical and biological methods of brush eradication and control; improvement of the forage stand through artificial revegetation measures, if necessary, together with any required maintenance operations, to prevent the sprouting of new brush plants; and effective management practices to obtain maximum sustained yields of both forage and livestock.

Stockmen have become increasingly concerned over this brush

problem. Some progress has been made in the development of mechanical and chemical methods of brush control. Studies on methods of controlling mesquite began in 1939 at the Spur station. It was not until 1947, however, that an overall research

Figure 76. Whitebrush forms dense stands on fertile bottomland soils in the Rio Grande Plain.

project on brush control was established in the Department. This program was expanded in 1948 to coordinate experimental work on this complex problem throughout the State.

Principal emphasis is being placed on the determination of suitable chemical control measures for the more important species of noxious brush.

An analysis of the problem and a survey of present knowledge on brush control practices has been published.

The study phases and principal species of brush covered at the various work centers in the program are:

Spur: plot tests of chemical herbicides on mesquite; physiological studies; grazing management in relation to brush control.

Winter Haven: plot tests of chemical herbicides on whitebrush and blackbrush; physiological studies on whitebrush.

Beeville: plot tests of chemical herbicides on blackbrush, prickly pear and huisache; mechanical control of blackbrush.

Stephenville: mechanical and chemical control of post oak and blackjack oak.

Sonora: mechanical control of live oak and shin oak.

College Station: plot tests of chemical herbicides on post oak, blackjack oak, yaupon and Macartney rose; livestock feeding trials of Macartney rose seed; grazing management and vegetational succession studies in cedar-eradication areas; successional studies in mesquite-eradication areas; and specialized laboratory studies.

Mechanical Control

Numerous mechanical methods of brush removal and control have been developed and used by ranchmen for range improvement with varying degrees of success. In many instances machines such as the bulldozer, tractor-driven saw, root-cutter and the rolling-type cutter are used to remove dense growths of brush to facilitate livestock management. It is recognized that continued maintenance may be necessary to control sprout regrowth and seedling reinvasion. Many of these are considered as "stop-gap" methods because they are costly and cause disturbance of the soil and damage to the residual stand of desirable forage plants.

Experimental work with mechanical methods of brush removal and control was devoted to surveys of operating costs and comparison of methods to determine their effectiveness on comparable areas.

At the Sonora station, a comparison of single-cabling, double-cabling and bulldozing was initiated in January 1949 in a brush type consisting principally of live oak and shinnery oak. The effectiveness of the treatments in the prevention of sprout regrowth and on forage composition and yield are being studied on permanent plots and enclosures. The possibilities of the root-cutter and bulldozer methods in the control of whitebrush or beebrush are being studied in experimental treatments conducted in 1949 in Llano county. Preliminary results indicate that these methods are too costly and that they result in excessive soil disturbance in the granite soils common to this area.

Effective control of woody species was obtained in some instances by repeated mowing. A treatment study is underway at the Beeville station to test the effects of successive yearly mowings of blackbrush with a mobile saw at various growth stages. No seasonal differences in effectiveness of treatment were found during the first year of the study.

Continued use of some of these mechanical methods of brush removal may be expected, particularly in brush types resistant to chemical treatment, such as cedar, live oak and shinnery oak. In other brush types, the desirability of combining mechanical eradication and chemical control is foreseen.

Chemical Control

Although mechanical treatments have been used extensively by individual ranchmen throughout Texas, recent developments in chemical herbicides give promise of more effective methods of brush eradication and control.

Various herbicides are being tested in a comprehensive program on most of the invading brush species, Figures 77 and 78. These screening tests are conducted on an individual plant or small-plot basis. Materials are applied in various formulations, concentrations, rates and seasons of application to foliage, trunk, stump and sprout growth. Chemicals found promising in these preliminary trials will be tested further in large-scale plots in an effort to find treatments that can be applied at a reasonable cost and with lasting effects.

Preliminary studies at the Winter Haven station and at College Station indicate that the effectiveness of treatment varies with the portion of the plant sprayed. Spray applications on freshly-cut stumps of blackbrush, whitebrush and oak gave higher kills than treatment of the standing plants or sprouts. Considerable variation among species was found in the effectiveness of foliage sprays. The application of selective herbicides to sprout growth generally gave poor results. Preliminary trials indicated that trunk sprays offer promise for some of the larger plants.

The physiological conditions of the plant at the time of treatment undoubtedly play an important part in the reaction of the plant to various herbicides at different seasons. Some variation in the effective season of application was found among the species studied. For instance, foliage sprays on both blackbrush and whitebrush at Winter Haven were more effective when applied at periods other than during initial spring growth. The same trend was noted in the treatment of blackbrush stumps, but there was no difference between the seasonal treatments of whitebrush stumps.

The results of these preliminary screening trials on the various species may be summarized as follows:

Whitebrush, beebrush. Important in the Rio Grande Plain and in the Central Basin; often forming pure mixed stands with mesquite, granjeno and other brush in fertile alluvial soils of drainages.

Resistant to 2,4-D and 2,4,5-T esters and ammate in water and oil solutions applied as foliage sprays; best results were obtained from stump treatments.

Blackbrush. Dominant on caliche soils in the Rio Grande Plain; often occurring in mixed brush types, particularly with guajillo.

Figure 77. Testing the effect of chemical herbicides on post oak brush.

Figure 78. An experimental airplane spraying a herbicide at the Spur station to determine its effectiveness in the control of mesquite.

Resistant to ester formulations of 2,4-D and 2,4,5-T in water and oil solutions applied as foliage sprays; defoliation and partial kill effected by ammate in foliage and stump spray applications at Winter Haven. The results obtained on stump treatments at the Beeville station are not in accord with those from the Winter Garden area and point to the need for additional research.

Post oak and blackjack oak. Dominant in the oak-hickory belt and in the East and West Cross Timbers where the vegetational aspect has changed from that of a savanna to dense brushy or woodland types.

Stump treatments consisting of the isopropyl esters of 2,4-D or 2,4,5-T in oil solutions in combination with ethylene dibromide show considerable promise; effective results obtained in spring and fall treatments with ammate applied in notches in the trunks as a powder or in solutions of 1 pound per gallon of water; applications of herbicides generally more effective during the spring.

Yaupon. A common evergreen underbrush in hardwood forests of East Texas; an invader of abandoned cultivated land. Little variation was found with application at various seasons; fall treatments with isopropyl esters of 2,4-D and 2,4,5-T in kerosene appear to warrant further study.

Prickly pear. A common invader of pastures throughout the Coastal Plain.

Resistant to water solutions of 2,4-D and 2,4,5-T, but oil solutions and emulsions of 2,4,5-T esters offer a possibility of control when applied during the growing season; fortified oil sprays and water solutions of TCA (sodium trichloracetate) were less effective than the selective herbicides.

Huisache. A common invader of pastures throughout the Coastal Plain.

Comparable to mesquite in response to herbicide treatment; variable and unsatisfactory results were obtained with foliage, sprout and trunk spray applications of 2,4-D and 2,4,5-T esters in oil and oil emulsions.

Macartney rose. A widespread invader in the Coastal Prairie.

Susceptible to 2,4-D and 2,4,5-T esters in water solutions in preliminary trials but inconsistent results were obtained in practical applications; no beneficial effects were obtained by the addition of ammate or by mixing the two hormones.

In summary, the use of chemicals to control and eradicate the noxious brush species on rangelands offers the greatest possibilities for the treatment of large areas within a reasonable time. However, more research is necessary to determine the chemical agents that will give the desired results at a reasonable cost to the ranch operator.

Management and Recovery Following Brush Eradication

The initial removal of brush by mechanical or chemical methods is but a single step in the development of productive ranges. Continued maintenance to control brush sprouts and seedlings, artificial revegetation to establish a forage cover where desirable grasses are lacking, and judicious use of the range by livestock to manipulate vegetational recovery toward the desired cover are all necessary for the restoration of brush-infested land to its full production. Management practices for each range unit must be keyed to the particular site and its conditions and vegetation and the type of eradication treatment used.

Management problems become complex in situations where the selective removal of one brush type results in the spread of other noxious forms through release of competition between brush species. The cedar type of the Edwards Plateau is a good example of this changing management pattern necessitated by brush removal. Live oak and shinnery oak tend to increase following cedar cutting in parts of the Plateau region. Goats are used as a management "tool" in these areas for the control of oak by rotational systems of grazing. Burning is commonly practiced in the "cedar breaks" following cedar cutting to provide freedom for livestock movement and to reduce the establishment of brush seedlings. This diversity in treatment and management results in a complex pattern of successional stages in vegetational recovery within a relatively small area. Detailed studies of vegetational recovery following cedar removal were made in Kerr and Real counties during the summer of 1949. It is believed that this study will yield valuable information on the effects of burning and management practices on range recovery in this important grazing region.

The necessity of establishing an adequate cover of grasses, either by artificial or natural methods, was emphasized in successional studies of abandoned crop land in Dimmit county. Brush species, particularly mesquite, showed a rapid rate of establishment and more than 1,200 plants per acre were observed on abandoned areas. Perennial grasses failed to become established to any extent until more than 8 years had elapsed since abandonment.

Factors Governing the Establishment of Brush

Livestock and other animals are important agents in the dissemination of the seed on many noxious brush species. Feeding trials with the seed of the Macartney rose showed that 57 percent of the ingested seed were recovered from cattle in condition to germinate. Laboratory germination trials underway for nearly a year resulted in germination only from seeds which were fed to animals. Similar results were obtained with mesquite seed.

THE POISONOUS PLANTS PROBLEM

There are more than 60 species of plants on the range lands of Texas that are considered poisonous to livestock. About half are of major importance in specific localities during certain seasons. These are, in the main, native plants of the areas and, almost without exception, have become prominent and troublesome with overgrazing.

Bitterweed is probably the largest poisonous-plant killer of range animals in Texas. Heavy sheep losses are frequent on dry winter and spring ranges, occasionally up to 50 percent, Figure 79. Death losses were recorded in a few instances for

Figure 79. A typical, green mouth, bitterweed sheep. Most ranchmen observe animals daily and put sick ones on dry feed. If animals will eat and do not die before reaching headquarters, a fair percentage of recovery is obtained. The sheep in this picture had been up 2 days and had not eaten.

cattle eating dry bitterweed on winter ranges, mostly in the Edwards Plateau country. The plant is well distributed over West Texas and is constantly spreading, especially in the Trans-Pecos area.

There are three recognized methods of control of bitterweed. The most important is range management, which includes lighter stocking and deferred grazing. It also may entail rotational grazing, change of animal types, increased waterings and smaller pastures. Killing with chemicals and hand pulling, the other two

methods, are practiced by many ranchmen, but the value of eradication is negligible unless used as an adjunct to good management, Figure 80.

Figure 80. Field crew determining the percentage kill of bitterweed by 2,4-D. Counts are taken from narrow belt transects in treated plots. Notice the increased grass growth in the treated plot.

Lecheguilla is taking a heavy toll of sheep as well as cattle and goats in portions of the Edwards Plateau and the Trans-Pecos. Losses of from one or two animals to as many as 5 percent of the flock are frequent. One ranchman reported a 50 percent loss of sheep between January and May. He attributed about half the loss to lecheguilla and the balance to "plain starvation."

Sacahuiste, which causes "swellhead" or "fevered" poisoning among sheep, goats and cattle, continues to be a problem in parts of the Edwards Plateau and across the Trans-Pecos area. When rainfall is low and range forage is scarce, especially during the winter months, sacahuiste furnishes the major green forage on many ranches until early summer. When sheep and goats are on ranges occupied by sacahuiste during the blooming season, the flowers are readily eaten and a high mortality results. Most ranchmen recognize this period of danger and move stock out of infested pastures to prevent loss. Sacahuiste has been cleared from some pastures by grubbing or burning, but many ranchmen value the plant for the cattle forage it produces.

Bud poisoning, or oak bud poisoning, in both live and shinnery oak areas is fairly common during the spring season. The usual

practice is to keep cattle out of oak areas until the leaves are fully formed and the danger period is past. In several instances, the movement of cattle into pastures too early has resulted in loss.

The Big Bend area of Texas has more species of poisonous plants which cause periodic trouble than any other unit area of Texas. Ridell's and wooly groundsel, Figure 81, caused more

Figure 81. Enclosure used to check data on wooly groundsel in Brewster county. All larger plants in the plot area are groundsel. This range area is badly overgrazed.

trouble during the recent drouth in the Presidio-Culberson-Jeff Davis-Brewster counties area than any of the other species listed as of major importance for the region. The jimmy fern has caused heavy losses of sheep on ranches in Culberson county and minor losses on other mountainous ranges in the Big Bend area. There are three species of loco in the Big Bend area but, due to the low fall and winter rainfall during the past 2 years, infestations of them have been negligible and little or no loss was reported. Losses from yellow weed were of greatest concern in the Presidio-Reagan counties region but also caused some loss in the Big Bend area. Baileya causes some loss of sheep and goats in the low rainfall areas of the Trans-Pecos. Scattered cases of plant poisoning were also recorded in the Big Bend for lechuguilla, rayless goldenrod, milkweeds, drymaria, broomweed, hairy caltrop and peavine.

The selective killing of poisonous plants with hormone sprays

is being experimented with in several localities. Baileya, Riddel's groundsel, wooly groundsel, garboncillo, wooly loco, narrowleaf loco and peavine are being treated on both small plot and pasture areas near the Animal Disease Laboratory in Presidio county. A series of treatments were applied to rayless goldenrod in Crane county. Various formulations are being tested on bitterweed in Runnels county. In addition, cooperative field work is being carried on in several counties by ranchmen and field workers.

The application of proper range management practices is the only ultimate means of meeting the poisonous plant problem. Medicated feeds, short, intensive grazing periods and weed-killer sprays have some merit, but ranges in good condition mean good forage.

Poisonous plants are not usually eaten when good forage is available. In most instances, perennial grasses and forbs will keep poisonous plants in check. When weeds become abundant through heavy range use, mechanical and chemical means may be needed to accelerate the improvement measures. A range in poor condition, producing little forage, especially in drouth years, is susceptible to an increase or invasion of poisonous plants and often leads to serious financial difficulties.

Veterinary Medicine

ANIMAL DISEASES

Pathological Conditions Accompanying Vitamin Deficiencies

Sheep feeders have often complained of heavy losses among sheep from occlusion of the urethra by calculi. These calculi result from the precipitation of calcium salts from the urine in the kidneys and bladder in the form of cheesy masses or concretions. Such masses often block the urethral passage and cause the death of the animal.

The exact cause or causes have not been determined but recently the suggestion was made that vitamin A may be involved. Vitamin D, the regulator of the calcium and phosphorus metabolism, evidently also plays a role, although this has not been emphasized.

In experiments conducted with 32 male sheep and goats fed a ration free of carotene, or vitamin A, and deficient in vitamin D, 25 died of uremia as a result of urethral occlusion within 15 months. Eighteen of these deaths occurred within 10 months. When a ration containing a bare maintenance of carotene (750 micrograms per 100 pounds live weight daily) and no vitamin D was fed, 27 of them died during the following 37 months, one-third of the deaths occurring in the first 15 months. In 10 of the 27, death resulted from urethral occlusion (7 during the first 15 months).

The percentage of animals dying from uremia following urethral occlusion was considerably reduced when adequate quantities of vitamin D were fed in addition to a maintenance amount of carotene, and when both carotene and vitamin D were offered in adequate quantities.

The most remarkable results were obtained when adequate amounts of vitamins A and D were offered in fish oil. Of 16 sheep fed a ration containing adequate A and D, none died from uremia resulting from urethral occlusion, nor were any urinary calculi found when the animals were slaughtered and autopsied.

Other experiments are underway which offer carotene extract in oil as a source of vitamin A and irradiated dry yeast for vitamin D in place of fish oil.

Brucellosis of Cattle

Neither sulfanilamide nor sulfapyridine showed any beneficial results in exploring the possibilities of the sulfonamide drugs in the treatment of brucellosis (Bang's disease).

Sulfamethazine and sulfadiazine were used in an attempt to prevent infection. Two cows under treatment with sulfamethazine and the non-treated control cow became infected and aborted following artificial infection.

Five cows treated with sulfadiazine at the time infection was attempted calved normally, while both the control cows aborted. Following calving, blood tests of the five treated cows showed three non-reactors and two reactors. These encouraging results emphasize the need for further testing of this drug.

A chronic case, however, failed to respond to sulfadiazine treatment.

Anaplasmosis of Cattle

Work was continued on the treatment of acute cases of anaplasmosis with two new anti-malarial compounds known as 1201 and 1290. Compound 1290 seemed to be more promising after trial of each on a few cases. As testing of this drug progressed, however, we were gradually forced to the conclusion that it was too toxic. The death loss among treated cows was much higher than it would have been had the animals not been treated. The drug seemed to have no effect on the course of the fever nor upon the percentage of infected red blood cells.

Difficulty was encountered in obtaining a suitable strain of the organism for experimental use. The two strains used, one from Harris county and the other from Sutton county, killed the experimental cattle after a fever period too short to permit adequate treatment. This has been recognized as one of the great drawbacks in coping with the disease in the field.

Hyperkeratosis of Cattle (X-disease)

Preliminary surveys of this highly fatal disease of cattle have been made since it was brought to our attention in July 1946. It has since been diagnosed in cattle in some 50 counties in Texas, Figure 82, and has been reported in 37 states.

The cause of the disease is unknown. All efforts to transmit it to healthy cattle (the only known susceptible animal) have been unsuccessful and no efficient treatment has yet been developed. Animals of all ages are susceptible.

Intensive investigation of this disease is underway.

Fowl Typhoid in Turkeys

Fowl typhoid is a highly fatal, bacterial disease of turkeys. It is caused by *Salmonella gallinarum.*

The infection is transmitted through the egg as well as by mechanical means. No reliable treatment for infected flocks has been found.

Figure 82. A field case of hyperkeratosis (X-disease) which is highly fatal to cattle. Its cause is unknown.

Experimental and field trials during 1949 showed that sulfaquinoxaline in proper dosage promptly checked the mortality associated with the disease. When infected turkeys were given the drug continuously in the drinking water, mortality was held to a minimum.

Turkey hens that had received sulfaquinoxaline in the drinking water at the rate of approximately one part drug to 5,000 parts of water for one month, were able to tolerate the very high concentration of 1 to 2,000 in water for an experimental period of 49 more days. Shell texture, fertility and hatchability of the eggs and livability of the poults were not affected. The recommended therapeutic level of sulfaquinoxaline for fowl typhoid is from 1 to 4,000 to 1 to 5,000 in the drinking water.

Research underway shows that the mortality is checked when poults infected with fowl typhoid are given sulfaquinoxaline. The drug does not, however, rid the infected bird of the causative organism, since the disease re-occurs when the sulfaquinoxaline treatment is discontinued.

Newcastle Disease of Poultry

Newcastle disease, a relatively new fowl disease of virus origin, which affects the respiratory and nervous system, is now widespread in Texas. Chickens of all ages are susceptible.

The disease usually starts in chicks with a bronchitis-like disturbance. This is soon followed by a nervous disorder which may

cause leg paralysis. The neck may be twisted out of its normal position, Figure 83. The nervous disorder does not, as a rule,

Figure 83. This hen was infested with a strain of Newcastle virus isolated in the laboratory at College Station. This virus caused a 66 percent mortality in a laying flock and a 95 percent mortality in White Leghorn chicks 6 weeks of age.

affect all of the birds involved in an outbreak, while the respiratory disorder usually affects all chickens. Respiratory symptoms usually are seen among laying hens, but slight nervous disturbance may not always occur. A drop in egg production almost to zero within 4 to 5 days is characteristic.

There are no known medicinal remedies of any value for the prevention or cure of Newcastle disease.

Experimental evidence indicates that a satisfactory vaccine may be produced. The Station is attempting to produce an efficient dead virus vaccine from a locally isolated, very virulent strain of virus.

Coccidiosis in Chickens

Many methods of control for coccidiosis of chickens have been advocated. It is desirable in most instances for chickens to be exposed to the disease to build up resistance to it. Slight coccidial infection will eventually produce immunity, while massive infection will produce death in a short time. A sanitation program that prevents chickens from picking up too many coccidial oocysts at any one time is still of prime importance.

Much emphasis has been placed on sulfonamides for the control of the disease. The sulfa drugs, if improperly used, may produce undesirable effects, since they do not allow the immature coccidia to develop and hence prevent the establishment of immunity. When the use of the drug is discontinued, losses from coccidiosis may follow.

Methyl bromide fumigation of litter artificially contaminated with coccidia prevented an acute outbreak of the disease. A high mortality occurred on litter artificially contaminated with coccidia and not fumigated, Figure 84.

Infectious Sinusitis of the Turkey

Infectious sinusitis, also known as "swell head" and "turkey roup," is one of the more important infectious diseases of turkeys in Texas. Since it is infectious, it should not be confused with the sinusitis that may occur as a result of vitamin A deficiency.

Recent information supports the belief that a virus is the cause of the disease. Four strains of virus were isolated and propagated in embryonated chicken eggs from field cases of infectious sinusitis submitted to the poultry diagnostic laboratory for diagnostic purposes. The sterile egg material harvested from inoculated eggs has been capable of inciting a typical sinusitis when injected into the infraorbital sinus of susceptible turkeys. The various modes of transmission have not been ascertained, but field and laboratory observations show that it spreads by contact with infected birds once it has gained entrance into a flock.

Treatment studies were undertaken recently. Preliminary results indicate that both streptomycin and auromycin are effective against this infection when injected into the affected sinus. This work is still in the experimental stage, and its application and true value to the turkey producer must await further study.

Figure 85 shows a turkey with the natural infection, and the same turkey 5 days after treatment with streptomycin.

POULTRY DIAGNOSTIC LABORATORY

A total of 5,798 specimens, such as chickens, turkeys and viscera, were submitted to this laboratory for diagnosis during the past 3 years.

This service has increased greatly each year. About 2,738 specimens from 840 poultrymen were submitted during 1949.

The major diseases encountered were pullorum, Newcastle, coccidiosis, leucosis, fowl typhoid, botulism, hexamitiasis, malaria, paratyphoid, sinusitis of turkeys, blackhead and roup.

Figure 84. Top—an acute (massive) infection of cecal coccidiosis, 7 days after exposure, was responsible for the death of these chickens. Bottom—similar chick 7 days after being exposed to massive concentration of coccidia in the litter which had been fumigated with methyl bromide.

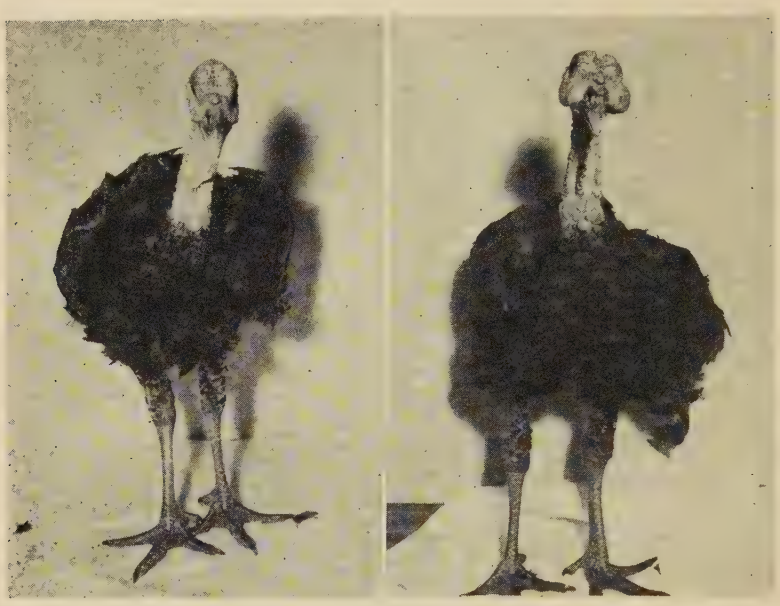

Figure 85. Right—turkey with a natural infection of sinusitus. Left—same turkey 5 days after treatment with streptomycin.

PULLORUM TESTING LABORATORY

Since this service was started on a state-wide basis in 1944, the number of reactors to the pullorum test have been reduced materially. The majority of the turkey breeding flocks in Texas are now classified as U. S. Pullorum Clean.

The number of pullorum tests (the total of the first through the fourth tests) conducted during the past 3 years are: 1947, 134,122; 1948, 58,770; and 1949, 84,390, giving a grand total of 277,282 tests in the 3 years.

Wildlife Management

Food Habits of the White-tailed Deer

A study of this deer was undertaken in the Edwards Plateau to learn its food habits and its numbers on the range so that its competition with domestic livestock for food could be determined.

It has been found that the best time to count deer is between 5:00 and 6:00 a.m., and 6:00 and 8:00 p.m., the latter hours being somewhat better. Counts taken at the evening period indicated that the deer population in Mason county in 1946-47 was approximately 161 per section; in 1947-48 it was up to 267. During 1946-47, the deer population in Kerr county was about 72 to the section, and by 1947-48 the number had risen to 130. Since seven deer consume about as much food as one cow, it is evident that the forage utilization by deer alone was high.

Results of food-habit studies to date seem to show that field observations of the animal eating naturally in the wild do not give a satisfactory index to what it eats. For example, efforts were made to determine what percent of the deer's daily eating activities was made up of browsing, grazing or consumption of mast or fruit. A total of 1,212 deer-feeding minutes involving 59 deer were recorded and classified during October, November and December. The results were compared with the analyses made of the stomach contents of 102 deer taken in November.

Stomach analyses showed that deer browsed on shrubs and trees a good deal more than was indicated by the observational method. In fact, browse items comprised more than 50 percent of the stomach contents. This discrepancy is probably because deer are more easily observed in open areas where they graze on weeds and grasses than in the brush.

Range Use by the Pronghorned Antelope

A study was made in the Trans-Pecos region to determine how much potential forage of domestic livestock is eaten by antelope on the range. Although antelope may hold their own in mountainous areas, rolling grasslands are their preferred habitat. The animals also do well in desert shrub, provided the land is grazed by cattle rather than by sheep. As shown by this study, food competition between the pronghorn and domestic sheep is keen, but there is little competition between antelope and cattle.

The food habits of antelope were determined both by observations of animals feeding naturally on the range, and by analyses

of stomach contents. It was found that their summer forage consists of about 62 percent forbs (weeds), 23 percent browse (brush) and 15 percent grasses. In the autumn, antelope consume about 59 percent forbs, 34 percent browse and 7 percent grasses. In winter, their food is about the same as in late autumn, with some variations when snow is on the ground. In spring, more attention is given to grasses and forbs.

Service Activities

FEED CONTROL SERVICE

The Feed Control Service is responsible for the administration of the Texas Feed Law. About 10,800 samples of commercial feed were examined under its jurisdiction during 1947, 1948 and 1949 to determine the presence of adulterations or other evidence of noncompliance with the law on the part of feed manufacturers. Analyses revealed that a great many lots of feed found in trade channels were offered for sale or were sold in violation of one or more provisions of the Texas Feed Law. Appropriate action was taken in all such cases to bring about correction. More serious cases and repeated violation were submitted to the courts for prosecution. Minor violations were corrected through correspondence or personal inspection. During this 3-year period, approximately 9,020,037 tons of manufactured feed were sold in regular trade channels in Texas, according to estimates based on the number of inspection tax tags issued.

It is encouraging to note that the quality of commercial feed appearing on the market is gradually improving. This is due in part at least to the equitable enforcement of the law and to the availability of a larger and better supply of ingredients.

The unprecedented demand for livestock and poultry feeds during the past several years has severely taxed the facilities of the Station in keeping the inspection service abreast of the movement of commercial feed. This tension is now being lessened, and the personnel of the Feed Control Service can devote more time to assisting manufacturers to turn out better feeds.

In addition to administering the law, much time and effort is given to compiling and disseminating information to feeders and manufacturers on various subjects pertaining to feed. Manufacturers are given instructions in the proper method of formulating feed ingredients for general and special purposes so that full utilization may be obtained, thus avoiding waste. Feeders are furnished data on the composition of feeds and the quality of ingredients, thus assisting them in the selection of feeds more suitable for their purposes.

STATE CHEMIST

The State Chemist is responsible for the administration of the Texas Fertilizer Law, for the analysis of official feed samples collected by inspectors of the Feed Control Service, and of insecticides collected by inspectors of the State Department of Agriculture. As chemist for the Texas Station, the laboratories of

the State Chemist also make a large number of routine analyses for the several subject-matter departments.

During the 3 years covered by this report, the laboratories analyzed approximately 5,000 samples of fertilizers, 11,000 samples of feed, 500 samples of insecticides, and 8,000 samples connected with research work. Each sample required the determination of several different constituents.

The Soil Testing Laboratory, which is organized under the State Chemist in the Department of Agronomy, has also analyzed approximately 700 samples of soil for farmers on a fee basis.

The use of fertilizers in Texas greatly expanded during this period. Sales during the fiscal year ending August 31, 1949 amounted to nearly a half-million tons as compared with a little over 200,000 tons during the year ending August 31, 1946. This expansion considerably increased the work associated with fertilizer control. However, close cooperation with the trade resulted in continuous improvement of the fertilizers offered to Texas farmers. The general average of the fertilizers available has improved in quality. The number of cases of violation of the requirements of the Texas Fertilizer Law was lower in 1949 than in any previous year.

The State Chemist is also charged by law with investigating the agricultural value of commercial fertilizers sold in the State. Research along this line has been considerably expanded. A number of investigations are discussed in the Agronomy and Horticulture sections.

STATE ENTOMOLOGIST

Apiary inspection work in the State is conducted under provisions of the so-called "Foulbrood Law" passed by the Texas Legislature in 1913.

Two crews of two inspectors each are engaged in this work. They inspected 71,332 colonies of bees belonging to 1,055 beekeepers in 91 counties during 1949. More beekeepers were visited than in 1948, but not quite as many colonies were inspected. American foulbrood disease, a bacterial infection, was found in 671 colonies, or 0.94 percent of the total number inspected. The infected colonies belonged to 140 beekeepers in 36 counties. AFB infection found during 1948 amounted to 0.82 percent. Although other brood and adult bee diseases have been found in Texas, no quarantine is placed on a bee yard except when American foulbrood is found. Honey for human consumption is not harmed by this or other diseases of bees.

Among apiaries inspected for the first time, 17.2 percent of the colonies were infected. In apiaries where AFB infection is

being eradicated, 4.6 percent of the colonies were infected. These figures indicate that approximately 73 percent of the American foulbrood disease found is eliminated each year.

European foulbrood, however, appears to be increasing. It was found in 10 bee yards. In some instances, it seems to be associated with AFB-resistant stock. It occurred in colonies of migratory beekeepers and also in isolated yards of non-migratory men.

Nosema is the most important of the adult bee diseases. Nearly 100 samples of bees were subjected to microscopic examination for presence of spores. Twenty-five of the samples were positive.

Several colonies of bees were found to have septicemia. It occurs in the blood of adult bees, but is not an important disease.

A new type of paralysis, which affects bright and young looking bees with full coating of hair, was observed for the first time. The more common form of paralysis caused by a virus gives the bees an old-looking appearance. The new type is caused by an unidentified bacteria.

Only 10,195 colonies with bees on combs were moved into Texas in 1949, about half as many as in 1948. Migratory beekeepers receiving permits in 1949 were from Colorado, Florida, Iowa, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Oklahoma and Wisconsin. Leading counties receiving these shipments were: Hidalgo, 4,330 colonies, including those relocated on second permit; Cameron, 1,369; Uvalde, 1,107; Bexar, 952; Zavala, 850; and Williamson, 661 colonies.

All beekeepers who moved colonies into Texas must receive permits from the State Entomologist at College Station. Issuance of these permits is based on a certificate from the state of origin that the bees were inspected and found free from infectious diseases. Permits were denied beekeepers in two instances.

Texas Substations and Field Laboratories
(See the map on the facing page)

Name	Location	Nearest highway	Year estab.	No. acres
SUBSTATIONS				
Beeville	5 mi. E. Beeville	U. S. 59	1894	450
Tyler	10 mi. NW Tyler	U. S. 69	1902	455
Chillicothe	5 mi. SW Chillicothe	U. S. 287	1905	253
Angleton	3 mi. NE Angleton	S. H. 35	1909	159
Beaumont	10 mi. W. Beaumont	U. S. 90	1909	605
Temple	2 mi. S. Temple	S. H. 95	1909	94
Denton	4 mi. W. Denton	S. H. 24	1909	335
Spur	1 mi. W. Spur	F. H. 111	1909	1,422
Lubbock	3 mi. E. Lubbock	U. S. 62	1909	160
Balmorhea	4 mi. E. Balmorhea	U. S. 290	1909	200
College Station	1 mi. NW College Station	S. H. 6	1909	266
Nacogdoches	2 mi. N. Nacogdoches	U. S. 59	1909	80
Sonora	28 mi. S. Sonora	S. H. 55	1916	3,462
Weslaco	2 mi. E. Weslaco	U. S. 83	1923	100
Iowa Park	2 mi. S. Iowa Park	U. S. 287	1924	162
Winter Haven	5 mi. S. Crystal City	U. S. 83	1929	192
Stephenville	3 mi. N. Stephenville	U. S. 281	1940	619
Ysleta	5 mi. E. Ysleta	F. H. 76	1942	190
Gonzales	7 mi. SW Gonzales	F. H. 108	1946	267
Prairie View	1 mi. W. Prairie View	U. S. 290	1947	1,000
Kirbyville	5 mi. E. Kirbyville	U. S. 96	1948	1,700
Bluebonnet	1 mi. W. McGregor	U. S. 84	1948	17,483
FIELD LABORATORIES				
College Station	Apicultural Laboratory	F. H. 60	1922	
Marfa	3 mi. NE Marfa	U. S. 90	1930	400
Lufkin	6 mi. SW Lufkin	S. H. 94	1934	218
Jacksonville	2 mi. N. Jacksonville	U. S. 69	1935	67
Yoakum	2 mi. E. Yoakum	S. H. 111	1937	13
Gilmer	2 mi. S. Gilmer	U. S. 271	1938	81
Montague	2 mi. SW Montague	S. H. 59	1938	56
Brazos Valley	8 mi. SW College Station	F. H. 60	1940	851
Robertson County	1 mi. S. New Baden	U. S. 79	1946	
Titus County	Mt. Pleasant	U. S. 67	1949	
COOPERATING STATIONS				
Big Spring	1 mi. N. Big Spring	U. S. 87	1913	185
Greenville	3 mi. SW Greenville	U. S. 67	1919	215
Brownwood	1 mi. E. Brownwood	U. S. 67	1930	127
College Station	Cotton Fiber Laboratory	S. H. 6	1936	
Riesel	1 mi. E. Riesel	S. H. 6	1936	841
Amarillo	14 mi. W. Amarillo	U. S. 66	1938	1,638
Encino[1]	10 mi. E. Encino	U. S. 281	1938	5,120
Brownsville	Ft. Brown, Brownsville	U. S. 77	1939	
Waco	100 yds. S. Circle	U. S. 77	1939	
PanTech[2]	18 mi. NE Amarillo	U. S. 60	1947	16,000
Brownfield	11 mi. W. Brownfield	U. S. 380	1947	320
Kerrville	6 mi. N. Kerrville	S. H. 16	1947	1,200

1King Ranch.
2Texas Technological College.
Other cooperating stations, USDA.

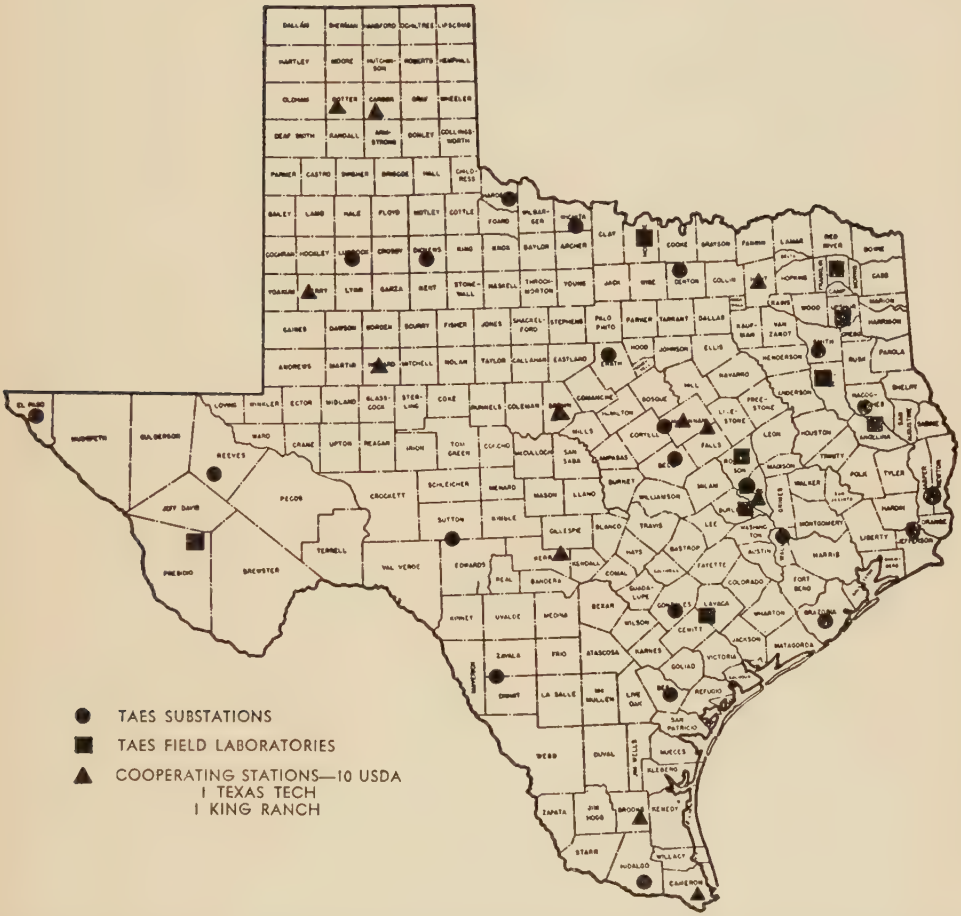

Figure 86. Research field units in Texas maintained by the Texas Agricultural Experiment Station and cooperating agencies.

RECEIPTS, TEXAS AGRICULTURAL EXPERIMENT STATION, FOR FISCAL YEARS 1946-47, 1947-48 and 1948-49

	1946-47	1947-48	1948-49
CASH ON HAND IN BANKS AT BEGINNING	$ 482,655.77	$ 459,248.48	$ 709,078.10
NET INCOME:			
State Appropriations			
Main Station	234,909.36	325,173.58	369,862.84
Substations	338,438.78	395,406.94	505,100.64
Field Laboratories		87,393.52	84,789.30
Total State Appropriations	$ 573,348.14	$ 807,974.04	$ 959,753.38
Sales and Services			
Main Station	132,514.08	312,692.00	334,990.11
Substations	314,646.47	270,358.27	421,324.84
Field Laboratories		45,739.57	68,341.60
Total Sales and Services	$ 447,160.55	$ 628,789.84	$ 824,656.55
Federal Funds			
Hatch	15,000.00	15,000.00	15,000.00
Adams	15,000.00	15,000.00	15,000.00
Purnell	60,000.00	60,000.00	59,999.95
Bankhead-Jones	161,288.81	164,269.82	173,212.47
Research & Marketing 9(b) 1 & 2		122,917.93	136,833.15
Research & Marketing 9(b) 3		78,950.00	63,300.00
Research & Marketing Title II			7,400.00
Total Federal Funds	$ 251,288.81	$ 456,137.75	$ 470,745.57
Interest on Bank Balances	4,960.89	5,005.69	4,994.26
Gifts and Grants			
Main Station	54,665.53	45,271.14	40,050.70
Substations	15,700.00	3,850.00	11,500.00
Field Laboratories		100.00	600.00
Total Gifts and Grants	$ 70,365.53	$ 49,221.14	$ 52,150.70
TOTAL NET INCOME	$1,347,123.92	$1,947,128.46	$2,312,300.46
OTHER CASH RECEIPTS:			
Feed Control Service Tag Sales	$ 279,278.18	$ 307,864.03	$ 316,169.01
Group Life Insurance Premiums	5,511.67	6,775.04	7,478.83
Federal Tax Withholdings	28,882.74	38,532.78	35,550.27
Teacher Retirement Withholdings	17,630.40	24,493.20	26,467.70
Employees Retirement System		566.00	526.80
State 5 Percent Revolving Fund		569.40	518.80
Transfer from A and M College		347,455.74	34,000.00
TOTAL OTHER CASH RECEIPTS	$ 331,302.99	$ 726,256.19	$ 420,711.44
TOTAL RECEIPTS	$2,161,082.68	$3,132,633.13	$3,442,090.00

EXPENDITURES, TEXAS AGRICULTURAL EXPERIMENT STATION, FOR FISCAL YEARS 1946-47 1947-48 and 1948-49

CLASSIFICATION:			
Operating Expenditures			
Salaries and Wages	$ 823,892.92	$1,164,664.59	$1,289,361.45
Consumable Supplies	240,261.54	283,099.62	309,023.08
Operating Expenses	73,570.15	120,111.02	169,547.72
Repairs and Alterations	50,104.58	.96,299.74	108,625.27
Total Operating Expenditures	$1,187,829.19	$1,664,174.97	$1,876,557.52
Capital Expenditures			
Lands and Betterments	110.50	1,554.50	30,885.00
Buildings	38,526.23	77,670.48	107,967.32
Improvements Other Than Buildings	14,328.48	31,419.15	34,576.02
Equipment	118,183.28	269,907.46	306,102.43
Total Capital Expenditures	$ 171,148.49	$ 380,551.59	$ 479,530.77
TOTAL	$1,358,977.68	$2,044,726.56	$2,356,088.29
OTHER CASH DISBURSED:			
Feed Control Service Revenues Remitted to State Treasurer for Credit to A. and M. College	$ 279,278.18	$ 307,864.03	$ 316,169.04
Wool Scouring Charges Remitted to State Treasurer	6,323.79		
Remitted to Southwestern Life Ins. Co.	5,492.04	6,803.06	7,489.64
Remitted to Collector of Internal Revenue	28,882.74	38,532.78	35,550.27
Remitted to Teacher Retirement System	17,630.40	24,493.20	26,467.70
Remitted to Employees Retirement System		566.00	526.80
State 5 Percent Revolving Fund		569.40	518.80
Photo. Lab. Bal. Transferred to A. and M. College	5,249.37		
Total Other Cash Disbursed	$ 342,856.52	$ 378,828.47	$ 386,722.25
CASH ON HAND AND IN BANKS ENDING	459,248.48	709,078.10	699,279.46
TOTAL EXPENDITURES	$2,161,082.68	$3,132,633.13	$3,442,090.00

Staff

TEXAS AGRICULTURAL EXPERIMENT STATION

March 15, 1950

ADMINISTRATION

Lewis, Robert D., Ph.D. ..... Director
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Patterson, Raleigh E., Ph.D. ..... Assistant Director & Professor
Burgin, Alyne ..... Director's Secretary
Dial, Pat G. ..... Pay Roll Supervisor
Hagler, Roy W. ..... Auditor
Higgs, Walter C. ..... Statistical Recorder
Hooker, Egbert W. ..... Chief Clerk
Moses, Tad ..... Editor
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Schember, Victor E., M.S. ..... Executive Assistant

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Magee, Aden C., M.S. ..... Associate Professor
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Motheral, Joe R., M.S. ..... Associate Professor
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*Paulson, Walter E., Ph.D. ..... Professor
*Russell, Daniel, M.S. ..... Professor
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Southern, John Hoyle, M.S. ..... Agric. Economist (BAE, USDA)

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Miller, Jr., Herbert F., M.S. ..... Assistant Professor
*‡Montfort, P. T., B.S. ..... Professor
Smith, Harris P., M.S ..... Professor (On leave)
Sorenson, Jr., Jerome W., M.S. ..... Associate Professor

Cooperators from Other Agencies

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Bennett, Paul M., B.S. ..... Research Assistant
Brown, Meta S., Ph.D. ..... Associate Professor
‡Cain, Jr., Shelby H., M.S. ..... Assistant Professor (On leave)
Celarier, Robert P., A.B. ..... Research Assistant
Cheaney, Robert L., M.S. ..... Assistant Professor
Collier, Jesse W., B.S. ..... Assistant Agronomist
Ellison, Frances Z., B.S. ..... Technical Assistant
Evatt, Nathan S., B.S. ..... Research Assistant
Fehrmann, Frances L. ..... Technical Assistant
*Ferguson, Carl E., Ph.D. ..... Associate Professor (On leave)
*Hampton, Herbert E., Ph.D. ..... Professor
Harvey, Clark, M.S. ..... Assistant Professor
Holt, Ethan C., Ph.D. ..... Assistant Professor
*Kapp, Lawrence C., Ph.D. ..... Associate Professor
Killough, David T., M.S. ..... Associate Professor (On leave)
Lang, Anton, Ph.D. ..... Distinguished Professor
‡Lewis, Charles F., M.S. ..... Associate Professor
Lofland, Jr., Hugh B., M.S. ..... Technical Asst. (On leave)
*McAfee, Thomas E., M.S. ..... Assistant Professor
McFarland, Edwin F., B.S. ..... Instructor
McKee, Gordon S., B.S. ..... Instructor
Maniord, Henry H. ..... Technician
Manning, Cleo W., M.S. ..... Associate Professor (On leave)
‡Mowery, Irvin C., B.S. ..... Assistant Soil Scientist
Oakes, Jr., Albert J., M.S. ..... Research Assistant
*Potts, Richard C., Ph.D. ..... Associate Professor
Rea, Homer E., B.S. ..... Associate Professor
Redman, Ernest J. ..... Technician
*Reeves, Robert G., Ph.D. .....Professor (In Genetics with A&M College)
Reynolds, Elbert B., Ph.D. ..... Professor
‡Richmond, Thomas R., Ph.D. ..... Professor
Rivers, George W., M.S. ..... Instructor
*Rogers, John S., Ph.D. ..... Associate Professor
Smith, James C., M.S. ..... Associate Professor
‡Templin, Edward H., B.S. ..... Professor
Vavra, Frank L. ..... Technician
Waddle, Bradford A., B.S. ..... Instructor

Waidhofer, Alice, B.S. .....Technical Assistant
*Watson, Jr., James R., Ph.D. .....Assistant Professor

Cooperators from Other Agencies

Kinman, Murray L., Ph.D. .....Agronomist (BPISAE, USDA)
McFadden, E. S., B.S. .....Professor (BPISAE, USDA)
Oakes, Harvey, B.S. .....Soil Scientist (BPISAE, USDA)
Russell, G. A., Ph.G., B.S. .....Agent (BPISAE, USDA)
Simpson, J. D., B.S. .....State Soil Scientist (SCS, USDA)

STATE CHEMIST

Fudge, Joseph F., Ph.D. .....Professor and State Chemist
Brown, Ewing E., M.S. .....Assistant State Chemist
Copeland, Dorothy L. .....Technical Assistant
Dale, Elora W., B.S. .....Technical Assistant
DeMottier, Jeanne F., Ph.C. .....Technician
Dunn, Dorothy E. .....Technical Assistant
King, Jean M. .....Technical Assistant
Michalski, Katherine, B.S. .....Technical Assistant
Nichols, Natalie B. .....Technical Assistant
Ogier, Thomas L., B.S. .....Associate State Chemist
Saunders, Johnnie K., B.A. .....Technician
Walker, Waldo H. .....Technician
Welch, Edna C. .....Technical Assistant

ANIMAL HUSBANDRY

*†Miller, Jack C., Ph.D. .....Professor and Head
*Berry, Raymond O., Ph.D. .....Associate Professor
*Butler, Ogbourne D., M.S. .....Assistant Professor
*Hale, Fred, M.S. .....Professor
Jones, John H., B.S. .....Professor
Jones, John M., M.A. .....Professor
Patterson, Raleigh E., Ph.D. .....Professor
*Riggs, John K., M.S. .....Associate Professor

BIOCHEMISTRY AND NUTRITION

*Lyman, Carl M., Ph.D. .....Professor and Head
Baker, John P., B.S. .....Research Assistant
Blaylock, Lynn G., B.S. .....Research Assistant
Brown, Charlesta L., B.S. .....Technician
Carr, Mary J., B.S., B.A. .....Technician
*Colby, Robert W., Ph.D. .....Assistant Professor
(In A. H. Dept. with A&M C.)
Dieckert, Julius W., B.S. .....Research Assistant
Halick, John V., B.S. .....Research Assistant
Harris, Stella L., M.S. .....Technician
Henderson, Mary B., B.A., B.S. .....Technician
Hildebrand, Hazel E., B.S. .....Technician
*Holman, Ralph T., Ph.D. .....Associate Professor
Hood, Donald W., B.S. .....Research Assistant
*Kuiken, Kenneth A., Ph.D. .....Associate Professor

Lovelace, Mildred C., B.S. ..... Technical Assistant
*Reiser, Raymond, Ph.D. ..... Associate Professor
*Richardson, Luther R., Ph.D. ..... Professor
Sample, Melba B., B.S. ..... Technician
Lamp, Beverly G., B.S. ..... Technician
Schlenk, Hermann, Ph.D. ..... Assistant Professor
Wallace, Carrie B., M.S. ..... Technician
Witten, Patrick W., B.S. ..... Research Assistant

Cooperators from Other Agencies

Crookshank, Herman R., Ph.D. ..... Animal Nutritions (BAI, USDA)
(Located at PanTech Farms)

DAIRY HUSBANDRY

*†Rupel, Isaac W., Ph.D. ..... Professor and Head
*Anthony, Wilson B., M.S. ..... Instructor
*Featro, Joseph G., M.S. ..... Instructor
*Hoecker, Wesley H., Ph.D. ..... Assistant Professor
*Leighton, Rudolph E., M.S. ..... Associate Professor
*Moore, Albert V., Ph.D. ..... Professor

ENTOMOLOGY

*†Johnston, Horace G., Ph.D. ..... Professor and Head
Ashby, Robert K. ..... Foulbrood Inspector
Benson, Ulysses H. ..... Foulbrood Inspector
*Bilsing, Sherman W., Ph.D. ..... Professor
Burgin, Claud J., B.S. ..... Chief Foulbrood Inspector
Dean, Herbert A., M.S. ..... Assistant Professor
*Gaines, J. C., Ph.D. ..... Professor
*Hanna, Ralph L., B.A. ..... Instructor
*Martin, Dial F., M.S. ..... Assistant Professor
*Price, Manning A., M.S. ..... Assistant Professor
*Reinhard, Henry J., B.S. ..... Professor
*Thomas, Frank L., Ph.D. ..... Professor and State Entomologist
Warne, Bert ..... Technician
Weaver, James N., M.S. ..... Research Ass't. in Apiculture
*Wipprecht, Read, B.S. ..... Technician

Cooperators from Other Agencies

Glick, P. A., M.S. ..... Entomologist (BEPQ, USDA)
Gorzycki, Louis J., B.S. ..... Field Aide (BEPQ, USDA)
Ivy, E. E., M.S. ..... Entomologist (BEPQ, USDA)
Rainwater, C. F., B.S. ..... Entomologist (BEPQ, USDA)
Scales, A. L., B.S. ..... Entomologist (BEPQ, USDA)

FEED CONTROL SERVICE

Brock, Fred D., Ph.G. ..... Chief
Holleman, Marcus P. ..... Assistant Chief
King, Rufus G., B.S. ..... Feed Inspector
Kirkland, Kenneth L., B.S. ..... Feed Inspector
Nettles, William T. ..... Feed Inspector
Perry, Cecil C., M.A. ..... Feed Inspector

Reynolds, Jr., Sidney D. ..... Feed Inspector
Thompson, Horace M. ..... Feed Inspector
Wickes, Henry G., B.S. ..... Feed Inspector
Wilson, Garland B., B.S. ..... Feed Inspector

FLORICULTURE AND LANDSCAPE ARCHITECTURE

*DeWerth, A. F., M.S. ..... Professor and Head
*Milne, C. Gordon, M.S. ..... Assistant Professor

GENETICS

*Godbey, Chauncey B., M.S. ..... Professor and Head
*‡Shrode, Robert R., Ph.D. ..... Associate Professor

HORTICULTURE

*†Adriance, Guy W., Ph.D. ..... Professor and Head (On leave)
*†Brison, Fred R., M.S. ..... Professor and Acting Head
Allison, Ethel R., B.A. ..... Technical Assistant
*Apple, Jr., Spencer B., M.S. ..... Associate Professor
*Blackhurst, Homer T., Ph.D. ..... Associate Professor
Brittingham, William H., Ph.D. ..... Professor
*Cain, Robert F., M.S. ..... Associate Professor
Culver, William H., B.S. ..... Research Assistant
*Krezdorn, Alfred H., M.S. ..... Instructor
*Mohr, Hubert C., M.S. ..... Assistant Professor
*Stephens, Thomas S., M.S. ..... Instructor

MAIN STATION FARM and BRAZOS RIVER VALLEY LABORATORY

Roberts, James E., M.S. ..... Superintendent
Royder, Douglas R. ..... Technical Assistant
Wolters, Freddie A., B.S. ..... Assistant Superintendent

PLANT PHYSIOLOGY AND PATHOLOGY

*†Dunlap, Albert A., Ph.D. ..... Professor and Head
‡Bird, Luther S., B.S. ..... Instructor
‡Ergle, David R., Ph.D. ..... Professor
*‡Joham, Howard E., M.S. ..... Assistant Professor
*McIlrath, Wayne J., Ph.D. ..... Assistant Professor
Rosberg, David W., Ph.D. ..... Assistant Professor
*Watkins, Gustav M., Ph.D. ..... Professor
*Whitehead, Marvin D., Ph.D. ..... Assistant Professor

Cooperators from Other Agencies

Eaton, F. M., Ph.D. ..... Principal Plant Physiologist (BPISAE, USDA)

POULTRY HUSBANDRY

*†Quisenberry, John H., Ph.D. ..... Professor and Head
‡Briles, C. O., B.S. ..... Research Assistant
*‡Briles, Worthie E., Ph.D. ..... Assistant Professor
*Couch, James R., Ph.D. ..... Professor

Draper, George H., M.S. ..... Poultry Supervisor
*German, Harry L., M.S. ..... Instructor
Grubbs, James R., B.S. ..... Poultry Supervisor
*Parnell, Edward D., M.S. ..... Professor
*Ryan, Cecil B., M.S. ..... Assistant Professor
*Sherwood, Ross M., M.S. ..... Professor
Thompson, Dortha H. ..... Technical Assistant
Thuem, Henry D., B.S. ..... Poultry Supervisor

RANGE AND FORESTRY

*†Young, Vernon A., Ph.D. ..... Professor and Head
*Darrow, Robert A., Ph.D. ..... Associate Professor
*Gould, Frank W., Ph.D. ..... Associate Professor & Curator
McCully, Wayne G., B.S. ..... Assistant Professor
Ruby, Ellis S., M.S. ..... Research Assistant
*Sperry, Omer E., Ph.D. ..... Professor
*Wilson, David G., B.S. ..... Instructor

RURAL HOME RESEARCH

Whitacre, Jessie O., Ph.D. ..... Professor and Head
Cover, Sylvia, Ph.D. ..... Professor
Fojtik, Josephine B. ..... Technical Assistant
Grimes, Mary A., M.S. ..... Professor
Schram, Geraldine H. ..... Technical Assistant
Smith, Jr., William H., B.S. ..... Technician
Thomas, Margaret K., B.S. ..... Technician

VETERINARY MEDICINE

*†Boughton, Ivan B., D.V.M. ..... Dean of Veterinary Medicine
*Boney, Jr., William A., D.V.M., M.S. ..... Associate Professor
‡Calliham, Melvin R., D.V.M. ..... Associate Veterinarian
... (Located at PanTech Farms)
*Edds George T., D.V.M., M.S. ..... Professor
Franklin, Ted E., D.V.M. ..... Assistant Professor
*Grumbles, Leland C., D.V.M. ..... Associate Professor
*Redmond, Harold E., D.V.M. ..... Associate Professor
*‡Schmidt, Hubert, D.V.M. ..... Professor
*Turk, Richard D., D.V.M., M.S. ..... Professor

WILDLIFE MANAGEMENT

*Davis, W.B., Ph.D. ..... Professor and Head

Cooperators from Other Agencies

Petrides, George A., Ph.D. ..... Associate Professor (FWS, USDI)

SUBSTATIONS

NUMBER 1—BEEVILLE, Route 1

Hall, Robert A., B.S. ..... Superintendent
Davenport, Marc G., B.S. ..... Ass't. Agricultural Engineer
Neal, Edward M., B.S. ..... Ass't. Animal Husbandman
Reyes, Lucas ..... Jr. Agronomist

Cooperators from Other Agencies

Kline, Gerald ..... Ass't Agric. Engineer (BPISAE, USDA)

NUMBER 2—TYLER, Route 5

Johnson, Paul R., M.S. ..... Superintendent
†Carpenter, Shannon E. ..... Assoc. Dairy Husbandman and Assoc. County Agent
Clapp, Jr., Norval F., B.S. ..... Jr. Plant Pathologist
Morris, Harry F., M.S. ..... Horticulturist

NUMBER 3—ANGLETON

Turner, William F., B.S. ..... Superintendent
Cauthen, George E., M.S., D.V.M. ..... Assoc. Veterinarian
Jackson, Francis C., D.V.M. ..... Ass't. Veterinarian
Riewe, Marvin E., B.S. ..... Jr. Agronomist

Cooperators from Other Agencies

Wade, L. L., B.S. ..... Jr. Parasitologist (BAI, USDA)

NUMBER 4—BEAUMONT, Route 5, Box 366, or as indicated

‡Davis, William C., M.S. ..... Superintendent
‡Tullis, Edgar C., Ph.D. (Box 2957) ..... Pathologist
Wyche, Robert H., B.S. ..... Agronomist

Cooperators from Other Agencies

Aldred, Fred, B.S. (Box 1952) ..... Agricultural Engineer (BPISAE, USDA)
Beachell, H. M., M.S. (Box 2957) ..... Agronomist (BPISAE, USDA)
Kramer, H. A., M.S. (Box 1952) ..... Agricultural Engineer (BPISAE, USDA)
Weihing, R. M., Ph.D. ..... Agronomist (BPISAE, USDA)
Moncrief, J. B., B.S. ..... Agronomist (BPISAE, USDA)

NUMBER 5—TEMPLE, Box 414

‡Johnston, Joseph R., Ph.D. ..... Superintendent
Hervey, Ralph J., M.S. ..... Ass't. Plant Pathologist
Stiver, Edward N., Ph.D. ..... Ass't. Agronomist
‡Tippitt, Olin J. ..... Agricultural Aide

NUMBER 6—DENTON

Dudley, Daniel I., B.S. ..... Superintendent
‡Atkins, Irvin M., Ph.D. ..... Agronomist
Gardenhire, James H., M.S. ..... Jr. Agronomist
Norris, Milton J., B.S. ..... Assistant Agronomist

NUMBER 7—SPUR

Dickson, Ray E., B.S. ..... Superintendent
Fisher, Charles E., M.S. ..... Agronomist
‡Marion, Paul T., M.S. ..... Ass't. Animal Husbandman

Cooperators from Other Agencies

Young, Dale W., M.S. ..... Ass't. Agronomist (BPISAE, USDA)

NUMBER 8—LUBBOCK, Route 1

Jones, Donald L. ..... Superintendent
Karper, Robert E., M.S. ..... Agronomist
‡Box, John, B.S. ..... Ass't. Irrigation Engineer
Owens, Jr., Willis L., M.S. ..... Assistant Entomologist
Ray, Levon L., M.S. ..... Jr. Agronomist
Thaxton, Jr., Earnest L., B.S. ..... Jr. Agronomist

Cooperators from Other Agencies

Colwick, Rex, M.S. ..... Assoc. Agric. Engineer (BPISAE, USDA)

NUMBER 9—BALMORHEA

Bayles, John J., B.S. ..... Superintendent
‡Tips, Thomas R., B.S. ..... Ass't. Animal Husbandman

NUMBER 10—F. AND B. STATION, Poultry Husbandry Department, College Station

McCall, Lacy J. ..... Supervisor

NUMBER 11—NACOGDOCHES

†Hutson, Howard C., B.S. ..... Superintendent and Assoc. Co. Agricultural Agent

NUMBER 12—CHILLICOTHE

‡Quinby, John R., M.S. ..... Superintendent
George, Donald W., M.S. ..... Ass't. Agronomist

Cooperators from Other Agencies

Stephens, J. C., M.S. ..... Agronomist (BPISAE, USDA)

NUMBER 14—SONORA

Dameron, Wallace H., B.S. ..... Superintendent
Carpenter, Oscar L. ..... Jr. Animal Husbandman
Hardy, William T., D.V.M. ..... Veterinarian
Merrill, Leo B., B.S. ..... Ass't. Range Management

NUMBER 15—WESLACO

‡Cowley, Walter R., B.S. ..... Superintendent
Bloodworth, Morris E., B.S. ..... Ass't. Agric. Engineer
Burleson, Charles A., M.S. ..... Ass't. Agronomist
Godfrey, George H., Ph.D. ..... Plant Pathologist
Hubbard, Jack L., B.S. ..... Ass't. Agronomist
Leeper, Paul W., B.S. ..... Technical Assistant
Maxwell, Norman P., M.S. ..... Ass't. Horticulturist

Riherd, Paul T., M.S. .....Ass't. Entomologist
†Trew, Jr., Ernest M., B.S. .....Assoc. Agronomist
Wene, George P., Ph.D. .....Entomologist
Williams, George R., B.S. .....Technical Assistant (On leave)

Cooperators from Other Agencies

Chada, H. L., Ph.D. .....Entomologist (BEPQ, USDA)
Cooper, W. C., Ph.D. .....Physiologist (BPISAE, USDA)
Ross, P. Earl, B.S. .....Engineering Specialist (SCS, USDA)

NUMBER 16—IOWA PARK

Brooks, Lester E., B.S. .....Superintendent
Woodfin, Virgil I., B.S. .....Jr. Horticulturist

NUMBER 17—YSLETA, Route 1, Box 66

Lyerly, Paul J., Ph.D. .....Superintendent
Bryant, Myron D., M.S. .....Ass't. Horticulturist
Henry, Grafton F., M.S. .....Ass't. Cotton Breeder
Melton, Aurelious A., M.S. .....Ass't. Animal Husbandman
Perez, Adelina T. .....Technician
Stith, Lee S., M.S. .....Ass't. Cotton Breeder (On leave)
Willey, Norman B., B.S. .....Ass't. Animal Husbandman (On leave)

Cooperators from Other Agencies

Hare, Q. A., B.S. .....Entomologist (BEPQ, USDA)
Noble, L. W., B.S. .....Entomologist (BEPQ, USDA)

NUMBER 18—PRAIRIE VIEW

Smith, Oliver E., M.S. .....Ass't. Professor (Coop. P. V. A&M C.)
Williams, John C., M.S. .....Assoc. Professor (Coop. P. V. A&M C.)

Cooperators from Other Agencies

Smith, G. L., M.S. .....Superintendent (P. V. A&M C.)

NUMBER 19—WINTER HAVEN

McDowell, Cincinnatus H., M.S. .....Superintendent
Calvert, Oscar H., Ph.D. .....Ass't. Plant Pathologist
Mortensen, Ernest, B.S. .....Horticulturist
Perry, Bruce A., Ph.D. .....Horticulturist
Richardson, Ben H., M.S. .....Ass't. Entomologist

Cooperators from Other Agencies

Frank, F. A., Ph.D. .....Assoc. Agronomist (BPISAE, USDA)

NUMBER 20—STEPHENVILLE

Langley, Byron C., M.S. .....Superintendent
Denman, Tom E., B.S. .....Assoc. Horticulturist
McCullough, Welty E. .....Ass't. Agronomist

NUMBER 21—GONZALES

Reed, Jr., James R., M.S. .....Superintendent

NUMBER 22—KIRBYVILLE

Cook, Elton D., M.S. ..... Superintendent
Crane, Lloyd E., B.S. ..... Jr. Agronomist
Silker, Theodore H., M.S. . . Silviculturist (Coop. Texas Forest Service)

NUMBER 23—BLUEBONNET FARM, Box 567, McGregor, Texas

Hill, Henry O., B.S. ..... Superintendent
Davis, Stanley P. ..... Wool and Mohair Technician
Hargrove, Beal D., M.S. ..... Assoc. Agronomist
‡Warwick, Bruce L., Ph.D., D.V.M. ..... Animal Husb. & Geneticist

Cooperators from Other Agencies

Hazen, M. W., M.S. ..... Animal Husbandman (BAI, USDA)

FIELD LABORATORIES

APICULTURAL RESEARCH LABORATORY, Department of Entomology, College Station

Alex, Alfred H., B.S. ..... Assoc. Professor

ANIMAL DISEASE INVESTIGATIONS, Marfa

Vardiman, Phillip H., D.V.M. ..... Assoc. Veterinarian

DAIRY INVESTIGATIONS, Mt. Pleasant

†Buckingham, Mark ..... Dairy Husbandman

FRUIT INVESTIGATIONS, Montague

Randolph, Uriel A., M.S. ..... Assoc. Horticulturist

HORTICULTURAL INVESTIGATIONS, MILAM AND ROBERTSON COS., Dept. of Horticulture, College Station

Buffington, Gordon A., B.S. ..... Ass't. Horticulturist

EAST TEXAS PASTURE INVESTIGATIONS, Route 5, Box 181, Lufkin

Knapp, William C., B.S. ..... Ass't. Animal Husbandman

PLANT DISEASE INVESTIGATIONS, Yoakum

Harrison, Arthur L., Ph.D. ..... Plant Pathologist
Michael, Haskell T., B.S. ..... Jr. Plant Pathologist

SWEET POTATO INVESTIGATIONS, Gilmer

Michael, Ralph, B.S. ..... Assoc. Horticulturist

TOMATO DISEASE INVESTIGATIONS, Jacksonville

Young, Paul A., Ph.D. ..... Plant Pathologist

COOPERATING STATIONS OF OTHER AGENCIES

BIG SPRING FIELD STATION (USDA), Big Spring

‡Keating, Fred E., B.S. .....Superintendent (BPISAE)

BLACKLAND WATERSHED PROJECT (USDA), RIESEL Box 1583, Waco

‡Baird, Ralph W., M.S. .....Project Supervisor (SCS)
‡Woltman, Arthur G. .....Cooperative Agent (SCS)
Pope, J. B., B.S. .....Soil Conservationist (SCS)
Word, Jr., O. C., B.S. .....Agricultural Engineer (SCS)

COTTON FIELD STATION (USDA), Greenville

Hooton, D. R., B.S. .....Supt. & Assoc. Agronomist (BPISAE)
Porter, D. D., B.S. .....Ass't. Agronomist (BPISAE)
Saunders, R. F. .....Agronomist (BPISAE)

COTTON INSECT INVESTIGATIONS (USDA), Brownsville

Chapman, A. J., B.S. .....Entomologist (BEPQ)
Richmond, C. A., B.S. .....Entomologist (BEPQ)
Robertson, O. T. .....Entomologist (BEPQ)
Shiller, Ivan, M.S. .....Plant Quarantine Inspector (BEPQ)
Walton, O. L., B.S. .....Plant Quarantine Inspector (BEPQ)

COTTON INSECT INVESTIGATIONS (USDA), Box 1218, Waco

Ewing, K. P., B.S. .....Entomologist, In Charge (BEPQ)
Parencia, Jr., C. R., B.S. .....Entomologist (BEPQ)

COTTON FIBER LABORATORY (USDA), College Station

Burley, Jr., S. T., B.S. .....Cotton Technologist (PMA)
Eddins, F. S., B.S. .....Cotton Technologist (PMA)
Schultz, F. W., B.S. .....Cotton Technologist (PMA)
Wynn, F. M., B.S. .....Cotton Technologist (PMA)

LIVESTOCK AND RANGE INVESTIGATIONS (King Ranch and USDA), Encino

McBride, W. J., B.S. .....Agent in Animal Husbandry (BAI)

LIVESTOCK INSECT INVESTIGATIONS (USDA), Kerrville

Laake, E. W., Ph.D. .....Entomologist (BEPQ)

PECAN INVESTIGATIONS (USDA), Box 589, Brownwood

Romberg, Louis D., B.S. .....Assistant Horticulturist (BPISAE)

SOUTH PLAINS SANDY LAND LABORATORY (USDA), Box 151, Brownfield

‡Porterfield, Hugh G., B.A. .....Project Supervisor (SCS)

AMARILLO CONSERVATION EXPERIMENT STATION (USDA), Box 2169, Amarillo

‡Whitfield, Charles J., Ph.D. ..... Agronomist (SCS)
Hamilton, Roger D., M.S. ..... Ass't. Agronomist (TAES)
‡Johnson, Wendell C., M.S. ..... Ass't. Soil Scientist (SCS)
Arnold, M. L. ..... Agent (SCS)
Porter, Kenneth B., M.S. ..... Assoc. Agronomist (TAES)
Reeder, R. C. ..... Agent (SCS)
Swanson, N. P., B.S. ..... Irrigation Engineer (SCS)
Van Doren, C. E., B.S. ..... Soil Conservationist (SCS)